JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

SEPTEMBER, 1853.

## CIVIL ENGINEERING.

*On Various Irregular Motions of Locomotive Engines.* By D. K. Clark, Civ. Eng.*

In these days of railway casualties, too frequently, we fear, improperly called *accidents*, no apology is necessary for introducing the following observations from Clark's *Railway Machinery*—reviewed in last month's *Artizan;* and it is impossible to overrate their importance. As such, we invite to them the especial attention of our readers and contributors.

*Of the Pitching Movement.*—The resistance to pitching, and thereby the stability, is promoted by shifting the driving axle backwards, towards the fire box, principally because it increases the mass of the machine in advance of the axle, or that which is submitted to the oblique action of the connecting rod; the removal of the axle also, in so far as it lengthens the connecting rod, reduces the obliquity which is the source of the disturbance. In Crampton's engine, having the axle behind the fire box, the whole mass lies forward; while, at the same time, the guide bars, where the action takes place, are in the neighborhood of the centre of gravity; thus, the oblique action is entirely controlled, and the pitching is extinguished.

Above all, the number and position of the points of support, mostly control the pitching. The springs, also, particularly the fore and hind springs, should be as stiff as is consistent with the preservation of the frame and mechanism, to neutralize the oscillations which may arise from

* From the London Artizan, February, 1853.

imperfections of the permanent way—such as loose sleepers, open joints, or want of correct gauge; for if these oscillations should coincide with the action on the guide bars, they increase the straining of the machine, and the liability of the leading wheels to mount the rails. Susceptible springs, also, for the same reason, increase the danger from accidental obstructions.

*Vertical Action by the Centrifugal Force of the Revolving Weight.*—This action may be nearly neutralized by the application of suitable counter-weights. This question, however, belongs to the more general question of balancing all the revolving and reciprocating masses.

The reduction of adhesion, by vertical action, explains the occasional slipping of the driving wheels at high speeds. It explains also the extra wear of driving wheel tyres, when very much out of balance, next the crank pin, where the pressure on the rail is greatest, producing "flat places," and in consequence a vertical jolting of the engine while in motion.

*Longitudinal Fore and Aft Motion.*—It was found that in the sample engine a joint longitudinal action on the driving axle of above six tons, or three tons for each cylinder, was incurred at certain points of the stroke, at a speed of fifty miles, by the crank and the other moving masses. Now, the whole pressure of 100 lbs. steam on a fifteen-inch piston does not exceed eight tons; thus, the inertia of the mechanism alternately adds and subtracts three-eighths or 40 per cent. of this pressure, reducing the useful pressure to five tons, or 60 per cent., when the crank is at 45° during the first half-stroke; and raising it to eleven tons, or 140 per cent., at 135° in the second half-stroke. This example shows how very greatly the inertia of the machinery may affect the useful work of the engine. And, so long as the whole effective pressure in the cylinder exceeds this inertia, the coupling bars between engine and tender remain taut on their pins, though subject to oscillation with the coupling spring. But when the steam pressure is less, or altogether removed, with a small train, or going down an incline, they play fast and loose, owing to the fore and aft action, by which the machine is alternately thrown forward and backward on the tender. This explains the extra racket and jarring which takes place between an unbalanced engine and its tender immediately after shutting off the steam, in approaching stations, particularly where the nature of the coupling gear permits of some play. The shocks arising from these fore and aft vibrations are destructive to the coupling links and bolts, to the framing which carries them, and to the general connexion of the whole machine, especially at the axle boxes and guard plates. And the greater the play of the parts of the engine, the more injurious is this action.

To neutralize or soften the longitudinal action, it is usual to employ a traction spring under the foot plate of the engine or tender, to receive the shocks; it is either coupled to a draw bar of a fixed length, under permanent tension between the draw bolts, or adjustable by a double screw, right and left hand; in either case, buffing blocks of wood are fixed at some distance apart laterally, upon the front beam of the tender frame, to bear upon the engine frame, as fulcrums for the action of the spring. With the object of softening the action still further, the buffing

blocks are in some cases made elastic within a limited compass, by the use of india rubber springs. Counterweights, also, are applied to the wheels, and are efficient so far as they go; but they are, for the most part, much too light, as they are estimated for the revolving weight only.

*Of the Sinuous Movement.*—As this affection of the motion of the engine implies the lateral play of the fore and hind wheels upon the rails, the friction of the tyres upon the rails, due to this lateral displacement, is opposed to the motion, and its tendency is therefore to steady the engine. Accordingly, in practice, at the lower speeds, and when the intensity of the disturbing forces is low, the machine, though unbalanced, runs sufficiently steady in respect of sinuous motion. At speeds above thirty miles, the greater disturbing forces overcome the resistance to their development, and the sinuous motion becomes more violent, the higher the speed. Even in Crampton's ordinary engines, sinuous action becomes sensible when the speed reaches sixty miles.

Many things go to increase the sinuous motion to which the engines may be predisposed by want of balance; such as a want of parallelism of the axles, unequal diameters of the wheels, the wear of ruts or hollows in the tyres, the wear of the axle boxes and bushes, which gives rise to longitudinal and transverse play at the axle guards and on the journals, the outline of the rails, and sometimes a want of accuracy in the adjustment of the draw bars. When the axles are not parallel, but incline towards each other on one side of the engine, their disposition is to roll the engine forward in a curved path, and always towards the same side, causing perpetual collisions between the flanches and the rail. This oblique tendency is injurious enough on the straight parts of the line, but it is much worse on curves which diverge towards the other side, and increases the liability to get off the rails. The same tendency is caused by wheels of unequal diameter on the same axle. Again, when the tyre wears hollow, the outer part, originally less, is left larger in diameter than the middle of the breadth of tyre. This state of wear reverses the action intended in coning the tyres, as the greatest diameter, instead of being next the flanch, is shifted to the outside; and, whereas a properly coned tyre constantly seeks to maintain the wheels in the centre of the track, a hollow tyre leads the engine continually astray, and subjects it to constant concussions against the rail. Play of the axles and axle boxes, by giving scope for irregular action, converts what without play would be a simple strain or flexure of the guards, into shocks upon the journals and wheels laterally. And it must be noted that though some degree of flexibility in the frame may be beneficial for the easy working and adjustment of the machine to the rails, when in good order, it is a very dangerous accompaniment for a slack and unsteady engine. That these varieties of tear and wear are all productive of unsteadiness, is proved by the superior stability of a new engine, with all its parts well up to their gauges, and all its bearings taut.

The means employed to reduce the fore and aft movement operate also in reducing sinuous movement. A great extension of the wheel base has also been employed with benefit, because it reduces the angular play of the wheels between the rails, and increases the command of the leading wheels in controlling erratic movements, by their frictional resistance

transversely on the rails. In Crampton's engines, which carry out this principle to its limits, and impose the greatest loads upon the extreme wheels, the mass of matter in advance of the driving axle still further promotes the stability; and these engines, though they may not be balanced artificially, are practically steady at sixty miles per hour. But the great spread of wheels, though beneficial on straight lines, is prejudicial on the curves, and particularly in passing into sidings; for it is plain that the farther apart the extreme axles, the greater is the angle at which the leading wheel flanch meets the outer rail on curves, and the more severe is the labor of guiding the engine.

The springs between engine and tender, though useful for reducing the fore and aft motion, have been introduced chiefly to meet the horizontal oscillation. But it is clear that, in so far as they, and all similar appliances, reduce this movement, they tend to consolidate the engine and tender, and injuriously to increase the length of fixed wheel base. A draw spring between engine and tender is no doubt a good thing; but it should be employed rather as a mere carriage spring, to soften the irregular motions of the tender itself. The wheel bases of locomotives are abundantly long enough for the fair purposes of a carriage, and it is mechanically unsound in principle, and inexpedient in practice, to divert them from their legitimate function; for, as M. le Chatelier most justly observes, "it is only in a direct manner, by attacking and destroying the cause itself, that we should seek to extinguish the lateral oscillation of locomotives."

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*Experiments on the Blast and Exhaust Pressures in Locomotives.**

*Of the Influence of Exhaust Pressure on Blast Pressure.*—The exhaust pressure at the point of release, as it is a measure of the quantity and force of steam discharged, is the most proper datum for comparison with blast pressure. It has been found that the back exhaust pressure in the cylinder varies simply as the pressure at the release point. It is thus probable that the blast pressure (at a greater distance) should vary in the same ratio. The mean results of numerous observations confirm this inference, and, as a sample of the evidence, we may quote the following from C. R., No. 124, all taken in the course of a single trip:

TABLE No. XLI.—*Relation of Blast Pressure to Release Pressure.*—C. R., No. 124—1st Notch.

| Speeds. | Exhaust Pressure at release. | Blast pressure in inches of mercury. |
|---|---|---|
| m. p. h. | lbs. | ins. |
| 20 | 15 | 5½ |
| 19 | 23½ | 8¼ |
| 18 | 28 | 9 |
| 9 | 37 | 12¼ |

Each of these is a mean of two observations at nearly equal speeds and exhaust pressures, and it is plain that the blast pressure varies virtually as the pressure of exhaust at the release point.

* From the London Artizan for February, 1853.

*Of the Influence of Speed on Blast Pressure.*—In so far as the elevation of the mercury is due to the intermittent impulses of the blast, it may be conceived to be directly as the frequency of these impulses, or as the speed simply. Much of it is dependent also on the continuous expulsion of the residuary steam, and in so far it must vary as the square of the speed. The superior influence of the latter appears from the following observations selected to illustrate the influence of speed. The last column contains the blast pressures reduced for a mean uniform exhaust pressure at release, the reductions being made according to the law that the blast pressure is directly as the release pressure.

TABLE No. XLII.—*Relation of Blast Pressure to Speed.*

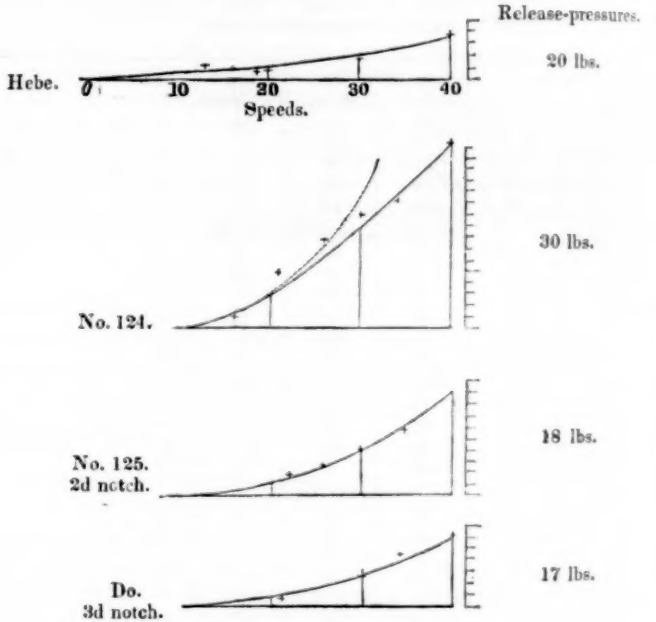
| Nos. of Observations. | Mean speeds of engine. | Mean release pressures. | Mean blast pressures. | Reduced blast pressures. | |
|---|---|---|---|---|---|
| | m. p. h. | lbs. | lbs. | ins. | |
| | E. & G. R. Hebe.—4th Notch. | | | | |
| 1 | 13 | 11 | $\frac{1}{2}$ | $\frac{7}{11}$ | for 20 lbs. release. |
| 2 — 5 | 17 | 26 | $\frac{3}{4}$ | $\frac{9}{13}$ | |
| 6 — 13 | 21 | 29 | $1\frac{1}{4}$ | $\frac{7}{8}$ | |
| 14 — 17 | 30 | 21 | $1\frac{3}{4}$ | $1\frac{3}{4}$ | |
| 18 | 40 | 11 | 2 | $3\frac{3}{8}$ | |
| | C. R., No. 124.—1st Notch. | | | | |
| 1 | 6 | 23 | $\frac{3}{4}$ | 1 | for 30 lbs. release. |
| 2 — 3 | 11 | 38 | $5\frac{1}{4}$ | $4\frac{1}{2}$ | |
| 4 — 6 | 16 | 39 | 11 | $8\frac{1}{4}$ | |
| 7 — 14 | 20 | 25 | $8\frac{1}{2}$ | 10 | |
| 15 — 19 | 24 | 30 | 11 | 11 | |
| 20 — 23 | 30 | 17 | $9\frac{1}{4}$ | $16\frac{1}{4}$ | |
| | C. R., No. 125.—2d Notch. | | | | |
| 1 — 2 | 12 | 20 | 2 | $1\frac{3}{4}$ | for 18 lbs. release. |
| 3 — 5 | 16 | 19 | 2 | $2\frac{3}{8}$ | |
| 6 — 9 | 20 | 19 | 4 | 4 | |
| 10 — 11 | 25 | 15 | $4\frac{3}{4}$ | $5\frac{3}{4}$ | |
| | Do. 3d Notch. | | | | |
| 1 | 11 | 13 | $\frac{1}{2}$ | $\frac{3}{8}$ | for 17 lbs. release. |
| 2 — 4 | 20 | 21 | $3\frac{1}{4}$ | $2\frac{1}{2}$ | |
| 5 — 11 | 24 | 15 | 4 | $4\frac{1}{2}$ | |
| 12 — 14 | 30 | 19 | 7 | $6\frac{1}{4}$ | |
| | Do. 4th Notch. | | | | |
| 1 | 16 | 12 | 1 | $1\frac{1}{8}$ | for 14 lbs. release. |
| 2 — 3 | 20 | 16 | $1\frac{1}{2}$ | 1 | |
| 4 — 6 | 27 | 13 | $1\frac{1}{2}$ | $1\frac{1}{2}$ | |
| 7 | 33 | 13 | 1 | 1 | |

In each series of pressures in the last column, it is clear that, except in the last case, the blast pressures rise very rapidly with the speeds. Throwing them into curves, in the usual way, we obtain the following results, (fig. 1,) for the respective examples noted. The last case, of No. 125, 4th notch, has been omitted, as the data are insufficiently distinct. The base lines contain the speed in miles per hour, and the perpendiculars express the blast pressures in inches of mercury. All the curves but the second follow the law of the variation of blast pressure as the square of the speed; the dot curve in the second case is constructed on this law,

but it is plain that the true curve is flatter, and indicates a law of variation inferior to the square of the speed, but superior to the speed simply. The other cases so distinctly harmonize with the law, that it may be inferred generally that the mean pressure at the blast orifice varies as the square of the speed, though occasionally (in exposed cylinders), the variation does not proceed so rapidly; but, in all cases, in a much higher ratio than the speed simply.

*Comparative Value of Blast Pressure and the Pressure of Exhaust.*—To compare these pressures directly, the former, indicated in inches of mercury; must be reduced to pounds; and as 30 inches of mercury balance 14·7 lbs. pressure per inch, we shall adopt 1 lb. of pressure as an equivalent for 2 inches of mercury.

Fig. 1.

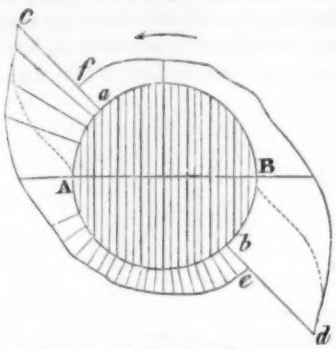



Curves showing relation of blast pressure to speed.

The mean blast pressure as measured by the gauge, results from the average indicated pressure of exhaust in the cylinders, exerted from the release point onwards to the point of compression. In each cylinder, usually there is a perpetual exhaust, as the valve no sooner closes the exhaust for one end of the cylinder than it opens it for the other. There are, therefore, two constant exhausts in operation, yielding jointly the blast pressure observed. Each exhaust is derived from a series of explosions, and is therefore variable in intensity. The variation in the cylinder is indicated directly on the diagram, ranging from the pressure at release to the lowest back pressure, and this may be otherwise represented as follows: let the line, A B, be the centre line of the engine, and the circle, A B, the path of the crank. This circle may be adopted for

an ideal atmospheric line, upon which the exhaust pressure that exists throughout one revolution may be represented. To select No. 15 diagram from the *Great Britain*, for illustration, divide A B, (fig. 2,) into 24 parts, as inches of stroke, and draw ordinates to meet the circumference. Assuming the crank pin to move in the direction of the arrow; then, as the exhaust opens at the 20th inch of the stroke, the point *a*, where the 20th ordinate meets the circle, is the position of the crank pin at the time of release of the back stroke; and *b*, diametrically opposite, is the position for the front stroke. From these points draw radial lines to *c* and *d*, representing the release pressure, 42 lbs., on the diagram. Similarly, from the ends of the other ordinates for each successive inch of stroke, occurring within the semicircle, *a* A *b*, draw radii equal to the successive exhaust pressures set forth on the diagram, terminating with *b e*, the back pressure of 11 lbs., at the point of compression. The curve traced through the extremities of these radii will represent the exhaust pressure for half a revolution due to the back end of the cylinder. The termination of this curve at *e*, coincides with the commencement of the duplicate curve of exhaust pressure, *d f*, for the front stroke; and it is clear that the pressure of exhaust, though perpetual, is abrupt and variable.

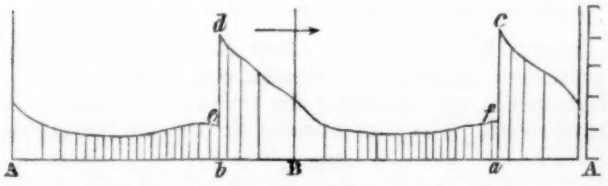
Fig. 2.




Great Britain.—3d Notch.—Variation of exhaust pressure in one cylinder during one revolution.

To represent this pressure on a straight atmospheric line, we may conceive the circular line, A B, to be unrolled flat with its ordinates attached. The diagram then assumes the appearance of fig. 3, in which the base line, A B A′, is equal to the circumference of the circle, A B, in the previous figure, and represents the path of the crank pin through one revolution. The ordinates being drawn from the points already found for them and connected by a curve, the curve so enclosed shows the exhaust pressure on a straight base line, for one cylinder, as before. The curve of exhaust pressure for the neighboring cylinder is of course precisely of the same form; and the two may be shown conjointly on opposite sides of the base. As the cranks are set at right angles on the axle, the re-

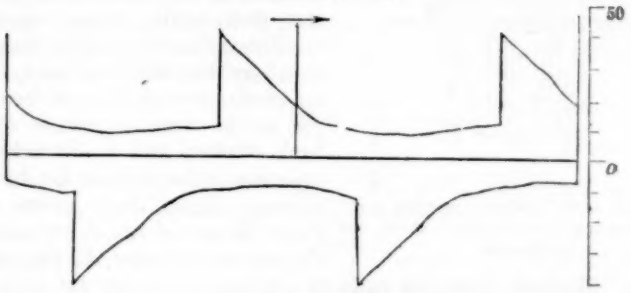
Fig. 3.




Variation of Exhaust Pressure, for one Cylinder.

lease points, represented at *d* and *c*, from one cylinder must occur at equal intervals between those from the other; and therefore the four explosions that occur during one revolution should be placed at equal intervals on the base line, as in fig. 4. To simplify the diagram, the whole area of pressure may be thrown to one side of the base line (as in fig. 5.), in which the ordinates from the second cylinder are superposed on the first series, and a

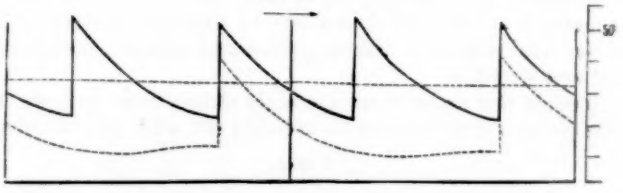
Fig. 4.




Variation of total Exhaust Pressure.—Compound Diagram for one revolution.

heavy-lined curve is traced over all, to show the lump pressure of the exhaust steam from the two cylinders during one revolution,—deduced

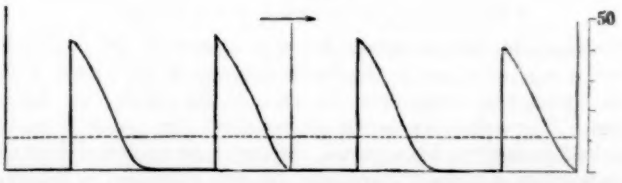
Fig. 5.




Great Britain, 3d notch, 46 m. p. h.—Previous Diagram simplified.

from the diagram No. 15 from the *Great Britain*. This figure clearly shows how far the joint pressure of exhaust may be reduced to a uniform force at high speeds, approximating the action of the blast to that of a steady jet of steam. The joint pressure, in this case, never falls below

Fig. 6.

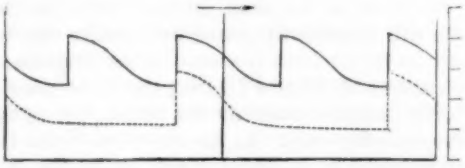



Great Britain, 3d notch, 11 m. p. h.—Variation of Exhaust Pressure for 2 cyls. 11 m. p. h.

21 lbs. in the cylinder; whereas, in fig. 6, showing the joint exhaust

pressure, in the same cylinders, at 11 miles per hour, drawn from No. 10 diagram, and projected in dot lining on fig. 2, we find the pressure developed in four distinct jets, each of which is isolated from its neighbors, and is thoroughly exhausted before the succeeding release takes place. The following figure, 7, showing in the same way the ordinary

Fig. 7.



C. R., No. 73, 30 m. p. h.—Variation of total Exhaust Pressure.

blast No. 73, C. R., at 30 miles per hour, still more obviously declares the approximation of the joint exhaust to a uniform pressure at high speeds. These illustrations explain, on the one hand, the clear "spit" of a well made engine with large ports and an easy orifice, proclaiming a rapid and efficient exhaust; and, on the other hand, the throttled shouts of overloaded steam ways, distressed by deficient dimensions.

The dot lines drawn in figs. 5 and 6, parallel to the base lines, indicate the mean exhaust pressures in the two cases, and measure respectively 33 lbs. and 11 lbs. Thus we perceive, in the latter case, a strong power of exhaust, capable of creating a blast without back pressure. A few examples of the proportional values of exhaust and blast pressures are contained in the following table:

Table No. XLIII.—*Comparison of Blast Pressure and the whole Pressure of Exhaust in the Cylinders.*

| No. of Diagram. | Speed of engine. | Release pressure. | Mean total exhaust pressure for one cylinder. | Mean back pressure of exhaust for one cylinder. | Mean blast pressure for two cylinders. | |
|---|---|---|---|---|---|---|
| | m. p. h. | lbs. | lbs. | lbs. | inches of mercury. | lbs. |
| | | | C. R., No. 73.—2d day. | | | |
| 1 | 25 | 41 | 16 | 10 | $4\frac{3}{4}$ | 2·4 |
| 2 | 32 | 29 | 11 | 6 | $4\frac{3}{4}$ | 2·4 |
| 3 | 32 | 35 | 16·5 | 13 | $5\frac{1}{4}$ | 2·6 |
| | | | Do. 3d day. | | | |
| 1 | 24 | 38 | 20 | 12 | $2\frac{1}{2}$ | 1·25 |
| 2 | 30 | 30 | 15 | 12 | $1\frac{3}{4}$ | 1·4 |
| 3 | 34 | 21 | 9 | 7 | $1\frac{1}{4}$ | 0·6 |
| 4 | 39 | 28 | 12 | 10 | $2\frac{3}{4}$ | 1·4 |
| | | | C. R., No. 124.—1st Notch. | | | |
| 1 | 6 | 23 | 3 | 2 | $\frac{3}{4}$ | 0·4 |
| 2 | 12 | 38 | 7·5 | 5 | $7\frac{1}{2}$ | 3·75 |
| 3 | 16 | 34 | 9 | 7 | $11\frac{1}{2}$ | 5·75 |
| 4 | 18 | 30 | 12 | 10 | 9 | 4·5 |
| 5 | 22 | 34 | 12 | 10 | 18 | 9 |
| 6 | 24 | 28 | 12 | 10 | $12\frac{1}{2}$ | 6·25 |
| 7 | 27 | 12 | 8 | 7·5 | $6\frac{1}{2}$ | 3·25 |
| 8 | 28 | 20 | 11 | 10 | 13 | 6·5 |

In the case of No. 73, the insignificance of the blast pressure, in respect

of the mean exhaust, is striking. For example, on the second day, a mean exhaust pressure of 16 lbs. for one cylinder, does not raise above 2½ lbs. of blast pressure for two; on the third day, still less. No. 124 yields higher values, as, with 12 lbs. mean pressure in each cylinder, it yields for the same speed of piston from 4½ to 9 lbs. of joint blast pressure.

Again, a comparison of the blast pressure with the simple back pressure of exhaust, will abundantly prove how unlike the "resistance of the blast pipe" may be to the back pressure of the diagram. While No. 73 shows back pressures of 12 and 13 lbs., the blast does not in any case rise above 2·6 lbs., and is commonly but ¼th to $\frac{1}{12}$th of the other, reckoning even for one cylinder only. On the other hand, the blast of No. 124 is much more formidable, in some cases, as in No. 5 diagram, being nearly equal to the back pressure for one cylinder, and in general fully one-half.

It was observed also, that during the experiments with the *Orion*, E. and G. R., the blast pressure remained almost unaltered at about ¾ lb., while the back pressure ranged from about 8 lbs. with foul water, to nothing with clean water, in the boiler. These remarks are sufficient to show that the resistance at the blast orifice constitutes but a part, and in many cases a very small part, of the total back pressure on the piston. For this conclusion, now verified by actual experiment, we should be quite prepared by the investigations on back exhaust pressure in the fifth chapter, where the influence of various circumstances was set forth. It was there inferred that the influence of the blast area on back pressure is sensibly nothing when it exceeds the area of steam way, and only operates when it is smaller than any other part of the exhausting passage. This conclusion also is verified by the blast gauge; for we shall find that it is generally in the cases of the smallest orifice in proportion to the steam port, that the importance of blast pressure is greatest. Thus, in the following table, containing the mean results of above a hundred observations, it appears that in the *Hebe* and No. 124, in which the blast orifice is decidedly smaller than the steam port, the total blast pressure is about one-half of the back pressure in each cylinder; whereas, in the *Orion* and No. 73, with wider orifices, the proportion of blast is sensibly small.

TABLE No. XLIV.—*Mean Ratios of Blast to Back Exhaust Pressure.*

| Name of Engine. | Ratios, that of piston being 1. | | Mean observed pressures. | | Ratio of blast to back pressure in one cylinder. |
|---|---|---|---|---|---|
| | Steam port. | Blast orifice. | Back pressure for one cylinder. | Blast for two cylinders. | |
| | | | lbs. | lbs. | |
| E. & G. R. Hebe, 4th Notch, . . | 1-13·6 | 1-1·5 | 2 | ¾ | ⅜ |
| E. & G. R. Orion, 5th Notch, foul water, | 1-14·7 | 1-12·2 | 8 | ¾ | 1-11 |
| Do. do. do. clean water, | 1-14·7 | 1-12·2 | 0 | ¾ | — |
| C. R., No. 73, foul water, . . . | 1-14·95 | 1-12·1 | 10 | 2½ | ¼ |
| Do. clean water, . . | 1-14·95 | 1-12·1 | 10 | 1⅛ | 1-9 |
| C. R., No. 124, 1st Notch, . . | 1-15·1 | 1-22·7 | 8 | 5 | ⅝ |

It is unnecessary to pursue this comparison further. We are only con-

cerned in showing by direct experiment the fallacy of charging blast pipe resistance, without limitation, with all the back pressure that occurs in the cylinder.

*Recapitulation.*—1. The pressure of the blast, gauged at the orifice, is developed in pulsations, due to the alternate discharges of steam from the cylinder; sharp and isolated at the slower speeds, and sensibly uniform at the higher.

2. Blast pressure varies directly as the exhaust pressure in the cylinder at the point of release.

3. Blast pressure varies, generally, directly as the square of the speed.

4. Blast pressure, gauged for two cylinders, is in all cases much smaller than the mean exhaust pressure, even for one cylinder. Also, it is in all cases smaller than even the back pressure of exhaust alone; and in many cases it forms but an insignificant fraction of the back pressure. It has been observed to vary from $\frac{1}{11}$th to $\frac{2}{3}$ths of the back pressure in each cylinder. Blast pipe resistance, therefore, constitutes but a part, and commonly but a very small part, of the observed back pressure in the cylinder.

5. The observation of blast pressure shows that the influence of the area of blast orifice on back pressure is sensibly nothing when it exceeds the area of the steam port, and only operates as a cause of back pressure when it is less than any other part of the exhausting passage.—*Clark's Railway Machinery.*

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### *The Submarine Telegraph between England and Belgium.**

On the 6th instant, a cable of seventy miles, in one entire length, was laid down between England and Belgium with complete success, and communications were instantly transmitted over 500 miles of submarine and subterranean line, with two of 24-plates battery only. The Mediterranean Electric Telegraph Company, propose to unite Europe with Africa by continuing the electric wires, which now run without interruption between London and Genoa, to Spezzia. From the latter port they will cross the Mediterranean to Africa, passing by the islands of Corsica and Sardinia. It is further proposed to construct a subterranean line from Algeria, along the coast of Africa to Alexandria: and, with the support of the British Government and the East India Company, it will be easy to prolong the wires to Bombay, where they will meet the great line of 3000 miles now in course of construction by the East India Company. The further end of this chain may ultimately be carried to Australia.

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### *The Submarine Telegraph between Great Britain and Ireland.†*

This important line of communication has at length been successfully effected by a submarine cable, manufactured by Messrs. Newall & Co., of Gateshead, and laid down by that firm on Monday between Donaghadee and Portpatrick. The cable consists of six communicating wires, insulated

* From the Journal of the Society of Arts, London, No. 27. † Ibid.

in gutta percha, and protected in the usual manner by an outer covering of iron wire. It could not be laid, as was intended, during the previous week, owing to the gales from the east preventing the opening of the dock gates at Sunderland to let the vessel containing it pass out. As several previous attempts to lay a submarine telegraph across the Irish Channel had failed, every care was taken to ensure the successful termination of the present attempt; and the expedition, consisting of the screw steamer *William Hutt* (with the cable and apparatus on board), the *Conqueror*, and the *Wizard*, left the Irish coast, having landed the end of the cable at a point about two miles to the south of Donaghadee harbor, and commenced the submersion of the cable, under the guidance of Captain Hawes, R. N., specially appointed by the Admiralty, who rendered great assistance in determining and directing the exact course to be pursued. The cable was landed on Wednesday morning, in a sandy bay (called Mora bay), a little to the north of Portpatrick.

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*A Description of the Newark Dyke Bridge, on the Great Northern Railway.* By Mr. J. Cubitt, M. Inst. C. E.*

The structure consisted of two separate platforms, one for each line of rails, carried upon two pairs of Warren's trussed girders, each composed of a top-tubed strut, of cast iron, opposing horizontal resistance to compression, and a bottom tie, of wrought iron links, exerting tensile force; these were connected vertically, by alternate diagonal struts and ties, of cast and wrought iron respectively, dividing the length into a series of fourteen equilateral triangles, whose sides were 18 feet 6 inches long; the actual span of the girders being 240 feet 6 inches. Each tube was composed of twenty-nine cast iron pipes, of $1\frac{1}{2}$ inch metal and $13\frac{1}{2}$ inches diameter at the abutment ends, increasing to 18 inches diameter with $2\frac{5}{8}$ inches metal at the centre of the span. The lower tie consisted of wrought iron links 8 feet 6 inches long, of the uniform width of 9 inches, but varying in number and thickness, according to the tensile strain to which each portion was subjected. The diagonal tie links varied from 9 inches by $1\frac{5}{8}$ inch to 9 inches by $\frac{3}{4}$ inch. The cast iron diagonal struts had a section resembling a Maltese cross, the area being in proportion to the compressive force to which they were subject. The total weight of metal in each pair of girders, composing the bridge, was 244 tons 10 cwt., of which 138 tons 5 cwt. were cast iron, and 106 tons 5 cwt. wrought iron, which with 50 tons for the platform, &c., made the total weight of each bridge 294 tons 10 cwt., or 589 tons for the whole structure; and the cost, exclusive of the masonry of the abutments, and of the permanent rails, but including the staging for fixing and putting together and the expense of testing, was 11,003*l*. In a series of experiments to test the stability of a pair of the trussed girders, at the works of Messrs. Fox, Henderson, and Co., where they were constructed, the following results were obtained. With a weight of 446 tons regularly distributed, which was equal to $1\frac{1}{2}$ ton per foot run, plus the weight of the platform, rails, &c., lowered seriatim on the thirteen compartments, the ultimate

* From the Journal of the Society of Arts, London, No. 27.

deflection in the centre was nearly $6\frac{7}{8}$ inches. With a weight of 316 tons equal to 1 ton per foot run, plus the weight of the platform, &c., as before, the ultimate deflection at the centre was $4\frac{1}{2}$ inches. When the bridge was fixed in its place, a train of wagons, loaded up to 1 ton per foot run extending the whole length of the platform, caused a centre deflection of $2\frac{3}{4}$ inches. The deflection caused by two heavy goods engines, traveling fast, and slowly, was $2\frac{1}{8}$ inches; and that produced by a train of five of the heaviest locomotive engines, used on the Great Northern Railway, was $2\frac{1}{2}$ inches in the centre.—*Proc. Inst. Civ. Eng., May* 24, 1853.

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## *Iron Roofs of Large Span.**

(From a paper by Mr. Robert H. Bow, C. E., of Edinburgh, read at the Royal Scottish Society of Arts.)

After some introductory remarks, and insisting upon the propriety of employing roofs of great clear span for principal railway stations, the author institutes a comparison between the different classes of structures employed for the principals of roofs; and deduces that the *triangular frame* (in which the rafters constitute the main compressed member of the fabric) deserves to be preferred before all arched, compound, or other forms, when an inclined surface is demanded by the covering, of the character required for slating. And he further shows, that where uniting or abutting principals can be used, rafters, when made straight and treated as bridges, form principals of a very economical character; but that, for such a situation, rigid arched structures are quite inadmissible.

He arranges those straight-raftered principals in which the rafters are the main compressed members, into two classes; the first class embracing those which are tied, or exert only vertical pressures on the supports; and the second, those which are untied or of the abutting character. The principals of the tied class are of two kinds; in the principals of the first variety each rafter acts as a bridge; but the principals of the second partake of the nature of a framed girder. The designs proposed by Mr. Bow, are of the former variety—that is, each rafter is treated as a bridge, and they may therefore be employed either in the tied or in the untied state. In order to test their merits as suitable forms for long spans, they are compared with the best form at present in use for long spans, and which is of the latter or girder character.

In the calculations undertaken in order to make the comparisons, the weight of each part is represented by the product of the successive multiplication of its length by its strain, and the allowance of metal per ton of strain. For *ties*, the sectional area of metal is estimated at one-eighth of a square inch; for *rafters* at a quarter of a square inch; and for the *struts* of the bracing at half a square inch for each ton of strain.

The accompanying tables give the results of his calculations. In these, however, the effect of that source of economy of material which arises from the peculiar fitness of the proposed forms for cases requiring many supported points, is alone made evident. But if the strains in the struts of the several forms be compared, it will be found that the strains

* From the London Mechanic's Magazine, June, 1853.

in the best form now in use are relatively less than as the squares of the lengths; and, consequently, the allowance of metal per unit of strain should be greater for the struts of that form than would be necessary for the struts of those proposed by Mr. Bow. And therefore were that fact taken into account in the comparison, results would be arrived at still more favorable to the new forms than those displayed in the tables.

*Comparative Weights of the Principals Nos.* 1, 2, *and* 3.

First Case.—When the sections of the Rafters are proportioned to the Strains.

No. 1 refers to the best form now in use, and Nos. 2 and 3 to two forms proposed by Mr Bow.

| No. | $N=16$ | $N=20$ | $N=24$ |
|---|---|---|---|
| 1 . . | 100·000 | 100·000 | 100·000 |
| 2 . . | 97·325 | 94·760 | 91·117 |
| 3 . . | 99.674 | —— | 92·129 |

Second Case.—When the Section of the Rafter is uniform.

| No. | $N=16$ | $N=20$ | $N=24$ |
|---|---|---|---|
| 1 . . | 100·000 | 100·000 | 100·000 |
| 2 . . | 89·882 | 88·387 | 85·796 |
| 3 . . | 89·353 | —— | 83·898 |

$N$=number of Bays in the Span.

*Comparative Weights of the Principals, Nos.* 1, 2, *and* 3, *when Nos.* 2 *and* 3 *are not tied.*

| No. | First Case. | Second Case. |
|---|---|---|
| 1 . . . | 100·000 | 100·000 |
| 2 . . . | 75·690 | 71·176 |
| 3 . . . | 78·046 | 70·653 |

Number of Bays in Span=16.

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## *On the Evaporation of Water in Steam Boilers.—From Clark's Work on Railway Machinery.**

We take from a review of a work on Railway Machinery by D. K. Clark, contained in the January number of the *Artizan*, the following recapitulation of the results at which he has arrived, with the hope that our engineers and manufacturers who are practically familiar with these things, will let us know how far their experience agrees with that of the author.

Ed. Journ. F. I.

*Recapitulation.*—The quantity or weight of water evaporable per hour, at a given rate of combustion, increases with the temperature at which the water is pumped into the boiler.

2. Consequently, the equivalent *weight* of water evaporable from the standard temperature, 62°, decreases as the initial temperature of the water actually evaporated rises, at such a rate, that the equivalent weights fall 1 per cent. for every 10° rise of initial temperature. At this rate only 85 per cent. of water evaporated from 212° would be evaporable from 62°.

3. The equivalent *volumes* of water evaporable from 62° also decrease as the inital temperature rises; but rather more slowly than the equivalent weights, inasmuch as water expands by heat; 88 per cent. of water evaporated at 212° would be evaporable at 62°.

* From the London Artizan, January 1, 1853.

4. The evaporative efficiency of locomotives depends very much on the management of the fire. Low fires, in general, evaporate more water than deep fires, as there is less coke exposed to waste; the proper use of the ash pan damper also promotes the economy of combustion, by regulating the draft to the requirements of the time.

5. A poundage of water, equal to 9 lbs. per pound of coke, is adopted as the standard of economical consumption, in practice.

6. The rate of evaporation per pound of fuel, or the *poundage* of water, is regulated by the area of the fire grate, the extent of heating surface, and the rate of consumption per hour. In general, the smaller the fire grate, the greater the heating surface; and the less the consumption per hour, within certain limits, the greater is the poundage of water.

Conversely, the poundage of water falls nearly as the rate of evaporation is increased above the economic limit, involving a reduced efficiency, and a heavy sacrifice of fuel.

7. The maximum economical hourly consumption increases directly as the grate area is reduced, even with the same heating surface; showing that the economic value of heating surface is increased by reducing the grate, and that by this simple expedient the same heating surface can economically evaporate larger quantities of water per hour.

8. The economical hourly consumption increases directly as the square of the heating surface, with the same grate; so that twice the surface would yield four times the consumption; showing that the economic value of each foot of surface is increased *by merely increasing the surface.*

9. The necessary heating surface increases only as the square foot of the consumption, the grate being the same.

10. The necessary heating surface increases as the square foot of the grate, the consumption being the same.

11. As the economic value of heating surface depends so much on the grate area being less as the area is greater, the grate should be kept as small as is consistent with the demands for steam, and the practicable rate of combustion. On the other hand, there can be no economical objection to any amount of heating surface which can be got into a boiler, even though greater than the economic limits. Thus there are two ways of meeting defective proportions—by increasing the heating surface, or by reducing the grate, either of which increases the economic value of the heating surface,—in other words, the economic evaporative power of the boiler.

12. The relations of grate area, heating surface, and economical consumption are such that

| | | | | | |
|---|---|---|---|---|---|
| with heating surfaces, | 30, | 60, | 90, | 100 | times the grate, |
| the maximum economical consumptions are | 2, | 8, | 18, | 22 | cubic feet of water per hour per foot of grate, |
| and | 14, | 55·6, | 125, | 153 | pounds of coke. |

13. The amount of clearance between the tubes affects the evaporative efficiency of the tube surface; and it ought to be greater, the greater the number of tubes. For ordinary good practice, on which the foregoing conclusions are founded, clearance at the rate of $\frac{1}{8}$ inch for every 30 tubes is sufficient; for example, $\frac{1}{2}$ inch for 120 tubes, $\frac{5}{8}$ inch for 150 tubes, and $\frac{3}{4}$ inch for 180 tubes.

14. The maximum rate of efficient combustion of good coke in the firebox has been found in practice to be about 150 lbs. per hour per foot of grate; and of evaporation, about 22 cubic feet of water per hour per foot.

15. The minimum weight of combustion worth anything for evaporation is probably about 14 lbs. per hour per foot of grate.

16. The maximum rate of combustion recommended for locomotive boilers is 112 lbs., or 1 cwt. of coke per hour per foot of grate, when the grate has at least 8 feet of surface; and of evaporation, 16 cubic feet of water per hour per foot.

17. These rates of consumption require a heating surface of 85 feet per foot of grate; and this is the lowest proportion that should be adopted for locomotive boilers.

18. A grate area of 4 feet is probably the smallest that should be adopted for railway purposes; and as the smallest grates require the greatest attention in firing, a consumption of about 76 lbs. of coke, and 11 feet of water, per hour per foot of grate, is the highest duty for which 4 feet grates should be designed; for large grates the duty may be increased up to the standard for 8 feet grates.

19. The evaporative capacity of locomotive boilers appears, so far as experience goes, to be the same at all speeds.*

20. The economic evaporative value of coal is, according to ordinary practice, about two-thirds of that of coke. But as coal is not likely to come into more general use as fuel, and will continue to be used only as an auxiliary with coke, it is not necessary to reconsider the proportions of the locomotive boiler with any view to the increased employment of that fuel.†

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For the Journal of the Franklin Institute.

## *Remarks on the Formation of Bars at the Mouth of the Mississippi River.*

By A. C. Jones, Esq.

To the Committee on Publications.

New Orleans, August 8th, 1853.

Gentlemen:—On May 4th, a well condensed synopsis of Mr. Ellet's report on the bars of the Mississippi river, appeared in the *Commercial Bulletin*, of this city, and on the 6th my remarks, (marked 1,) were pub-

* Assuming the efficiency of combustion to be the same, it might be deduced from previous discussions of the relations of evaporative power, blast pressure, vacuum in the smoke box, and speed, that the maximum rate of evaporation should be the same for all speeds. This question will be duly considered when we have to construct a general theory of the locomotive from the materials supplied by experiment.

† The author is gratified to find, from the later writings of Mr. Fairbairn, of Manchester, and Mr. Buchanan, of Glasgow, that his views of the economy of combustion and evaporation harmonize with those of these authorities. Mr. Fairbairn has, in his paper "On the Consumption of Fuel and the Prevention of Smoke" (1851), repeatedly recognised and set forth the value of a "*large heating surface as opposed to a small grate*," and the author is not sure but his formulas for economic proportions might apply to ordinary land or marine boilers. He feels certain that at least the principles on which the formulas are based will be found to apply to other classes of boilers.

lished in that journal; as only a part of the other communication is relevant to Mr. Ellet's theory, the rest may be omitted. Having just seen the book has induced me to send these on for republication.

Mr. E. gives, also, in support of the refluent current, the opinion of the pilots, which is, that this counter-current is the cause of vessels steering badly. Now, it is well known that most vessels answering the helm quickly in deep water st r wildly in shoal; hence this is no proof of this refluent current.

My opinion, published in 1841, and many times since, of the utter futility of attempting to improve the Passes of the Mississippi river, by any other mode than dredging a channel, and then keeping it open, is partly confirmed since. In 1843, the lateral outlet above the Passes, called the "Jump," was primarily caused by the shoaling of the Passes, and thereby not discharging the water fast enough during a rise, and the oyster canal* being the weakest point, the surplus was discharged through it; similar breaks will occur when the attempt is made to confine the discharge to one or two outlets.

The "scraping and stirring up plan" has been in operation several months by the tow boat company, to produce a depth of eighteen feet water on the bar, and so far their operations have done no good, as the water is now shoaler than when they began.

Respectfully, yours,

A. C. Jones.

*Note.—This canal was partly natural, and was only of sufficient dimensions to pass batteaux through it; the breech now is several hundred feet wide. For many miles (during high water,) the river is prevented flowing over the narrow strip of marshy ground on each side, by the trash collecting and forming a kind of levee.

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Mr. Editor:—Permit me, through your columns, to make a few remarks in relation to a part of Mr. Ellet's theory of the formation of the bars at the mouth of the Mississippi River. *Under my present circumstances*, (a few days before, I was burned out,) I can spare little time to such matters, and therefore will be as brief as possible.

Having had ample facilities to watch, daily, the formation and peculiarities of the bars, for nearly fifteen continuous months, I can speak advisedly on the subject, and am satisfied that if Mr. Ellet could have had the same opportunities to study their character, he never would have advanced his present theory.

It is well said that the Mississippi is *sui generis*, and yet gentlemen pass a few days about the bars, try a few isolated experiments, and found their theories thereon, which are given to the world with the weight of their professional reputations to back them; thus many conflicting theories about the bars are promulgated, and are ingeniously supported by their authors.

In 1838-9 the Northeast Pass was considered the best channel, and as it has gradually shoaled its water, it may be taken as a fair specimen of the influence now at work in shoaling the Southwest Pass.

Mr. Ellet states that the downward current, some miles above the bars, was of the same velocity as the water passing immediately over the bars. Knowing Mr. Ellet, I have not the slightest doubt that such was the case *at the time he observed it*. Now, I, and many others, have seen *no current on the bar when there was a current above the Passes*, and have many times witnessed an upward current on the north-east bar—twice, the *ascending current being within a fraction of three miles per hour*, and the water all salt at that. In fact, the current is retarded in one Pass and accelerated in others, simply by the influence of the wind blowing in the mouth of one, and backing up the water, which finds an outlet through the other Passes.

I suspect that Mr. E.'s experiments, in which he draws the conclusion that there is a

stratum of salt water passing upward to a certain point on the bar, must have been made after a change in the direction of the surface current, as the slow top current of the two miles seems to support, (I have seen a current which a well manned whale boat could scarcely stem,) or else it was made at a place where the influence of some inequality of the bottom caused an eddy. I tried hundreds of similar experiments, and never succeeded in discovering a refluent current. When the surface current was not affected by foreign influence, at times there was salt water on the bottom, and this from its greater specific gravity remained until the surface current had regained a sufficient velocity to communicate motion to the bottom portion, and then the lower stratum would become fresh; sometimes there would be some saltish water, but this had been forced in some of the other outlets, and passed this way back to the Gulf.

If Mr. Ellet had seen the Gulf perfectly calm, he would have noticed that there was a lateral current for some distance on both sides, which kept up the supply of that portion of salt water which received its motion from the column of fresh passing through it.

I cannot reconcile his theory of the lower stratum of salt water having a daily duty to perform, of bringing in a portion of the material the river formerly held in suspension, depositing it on one point of the bar, then rising, and passing back to the Gulf, to return with another load; if this was the case, it would take but a short time to stop up the outlets. Again, it would make a narrow bar, running across the channel. It has been proved by accurate soundings, taken by the survey in 1838, that the channel on the bars was nearly uniform in depth, and that it was up and down stream, then nearly five-eighths of a mile, and it has also been well attested, that the bars *do make both up and down*. As I am not making out a theory, what I state are facts, which passed under my own notice. During a sluggish current, the river water *does deposit* a portion of the material held in suspension, as was proved by experiment. I found this pulpy mass, so deposited, at times to measure in depth eighteen inches, and in some instances, within a day, it would be reduced to two or three inches; again, it would scarcely be perceptible on the crust of the bar. After easterly gales, the surface of the bar would be covered over with a clean sea sand; I at one time found it to be nearly one inch thick. Now, with an instrument I was enabled to test the bottom, and found that it consisted, below this upper covering (whether of sand or mud), of thin layers of sand and river deposits, forming a hard and compact stratified mass. As these stratas were well defined, from what I have stated, most persons would arrive at the conclusion that by the change of current and material, these stratas are formed, and thus shoals the whole surface of the bar. This will also account how the bar makes up stream, and also to the Gulf; and as the "mud lumps" assist, in the extension seaward, I will say a word about them. "Mud lumps," as they are miscalled, consist of pure clay,* (entirely different from the matter held in suspension by the water, which is more of the nature of loam;) it is proved to be composed of an impalpable material; in its natural state it is compact and tough, not easily washed or abraded by the action of the waves on it; when dried, it admits of a fine polish, which it retains for years.

These islands are forced up by subterranean agency sometimes twelve or fourteen feet above the surface of the water, with nearly perpendicular sides, and have always one or more salt springs discharging from their tops, a *much salter water* than that of the Gulf; along with this water comes bubbles of an impure hydrogen gas. Of course, where these islands are formed the current is retarded and the channel changed.

To obtain information of these "lumps," I had placed a skiff across the crater of a small one forming near the light-house, and let myself down through the pulpy mass to my armpits, when I found the bottom comparatively solid. I did not remain quite a minute, and yet the cold was so intense that, although I was in robust health, and the thermometer stood above 90°, it was nearly two hours before it seemed that I had a natural circulation at the extremities.

Respectfully, A. C. Jones.

* Imbedded in one of the mud lumps, or islands, there was a column (slightly inclined) of pure sand, which, by probing with a pointed iron rod, was at first mistaken for the trunk of a tree. All the rest of the island was pure alumine.

# AMERICAN PATENTS.

*List of American Patents which issued from July 19th, to August 9th, 1853, (inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

JULY 19.

27. For an *Improvement in Press Mould Candles;* Samuel T. Barnes, Columbus, Ohio.

*Claim.*—"What I claim is, the wick tube to guide and retain the wick in the centre of the candle, in combination with the wick, so arranged on a spool as to supply a continuous wick, as the tallow is forced out to form the candle, substantially in the manner described."

28. For an *Improvement in Processes for obtaining Chromates;* James C. Booth, Philadelphia, Pennsylvania; patented in England, November 9th, 1852.

*Claim.*—"I do not desire to claim separately as my invention such portion of the process herein before described as I have stated to be similar to that now in use for manufacturing chromate and bichromate of potash." "But what I do desire to claim is, 1st, The reduction of chrome ore by the carbonaceous materials, as herein described, as a stage in the manufacture of chromate of potash. 2d, The art or process of manufacturing chromate and bichromate of potash from chromic iron ore, by means of the reduction of the oxide of iron and the removal of the reduced iron by the several substances and modes, substantially as are herein enumerated and set forth. 3d, The process of reduction and removal herein described, in connexion with the old process of reduction herein described, or in combination with any equivalent therefor."

29. For an *Improvement in Feathering Paddle Wheels for Steamers;* Alexander H. Brown, Washington City, D. C.; patented in England, March 5th, 1853.

"The advantages possessed by my paddle wheel, in addition to those possessed by other adjustable wheels, are, 1st, the paddles having the curved form have a much greater propelling power than an ordinary flat paddle, as the paddle acts upon the water like the curved foot of the duck."

*Claim.*—"What I claim is, the combination of the pinion, back cam, and steering drum, with the eccentric, for the purpose of adjusting the paddles and converting them into a powerful steering apparatus." "I also claim the combination of the curved paddle with any apparatus for adjusting and feathering the same."

30. For an *Improvement in Mode of Driving Saws;* Issac Brown, Baltimore, Md.

*Claim.*—"What I claim is, the mode herein described of applying the power of the engine to the saw gate or frame, without being permanently connected therewith, so that the piston shall in a great measure be relieved from any lateral motion which the gate may have, which causes it to bind or cut in the cylinders, substantially as described."

31. For an *Improvement in Hanging Saws;* Nathan T. Coffin, Knightstown, Indiana.

*Claim.*—"What I claim is, the combination of the stirrup hung upon a knife edge, with the adjusting screws, for the purpose of regulating the rake of the saw in the manner described."

32. For an *Improvement in Lamps;* Charles J. Conway, City of New York.

"The objects of my invention are, first, to make the base of the lamp serve as a reservoir for the burning fluid; secondly, to establish such a communication betweeen the reservoir and the wick chamber, that the latter may be supplied from the former at any moment, by simply changing the position of the lamp; and, thirdly, to prevent any danger of explosion when the fluid used is of an explosive nature, by keeping it constantly confined within permanent and flame-tight limits."

*Claim.*—"I do not claim the peculiar property of small tubes, preventing the passage of flame; neither do I claim the making the base of the lamp serve as a reservoir for the fluid used; nor do I claim the construction by which no part is made movable, but the cap of the feeding tube." "But what I do claim is, that peculiar construction, by which two chambers or reservoirs are combined in the same lamp, one containing the wicks and

the fluid which saturates them, and the other forming the receptacle into which the fluid is poured, and the two chambers communicating by means of two pipes or tubes; the whole arranged and operating as described; by which means the wick chamber is filled, and may at any time be replenished from the larger reservoir by simply changing the position of the lamp from a vertical to a horizontal direction; and the larger reservoir may be suppled without bringing the can or fillers near the burners."

33. For an *Improvement in Spinning Jacks;* John Jackson, Lawrence, Massachusetts.

*Claim.*—"I do not claim stripping the bobbins preparatory to winding on; neither do I claim raising the "former," by a horizontal screw, giving motion to an inclined plane beneath it. But what I do claim is, the stop, in combination with the tappet on the gear, for the purpose of arresting the motion of the latter, at the instant the belt is shipped upon the pulley, that the gear may be left in the precise position necessary for the performance of another duty, the instant it is again set in motion, without being carried past this position by momentum and otherwise, when the brake is so arranged in connexion with the lever, or otherwise, that it shall be withdrawn by the mechanism which shifts the belt at the instant the gear is again set in motion; the operating the winding on mechanism, raising the stripping wire, and depressing the building wire, in the proper order, and then slipping the belt on the fast pulley at the close of these operations, by means of a single cogged gear, in combination with the tappet placed upon its side; the whole arranged and combined in the manner substantially as specified."

34. For an *Improvement in Eyes for Mill Stones;* Edmund Munson, Utica, New York.

"My invention consists in so constructing the eye of the stone, that the central cone supporting the runner shall be sustained by spiral wings extending from the cone to the inner surface of the eye; these wings so constructed as to prevent choking and clogging; and causing a current of air to pass into the eye and between the stones, thus facilitating the feeding of the grain and also supporting the stone."

*Claim.*—"I do not claim a conical form of a portion of the eye, nor do I claim a metallic eye, for they have been previously used and arranged in a variety of ways." "But what I claim is, the spiral wings, arranged in such manner as to perform the double office of feeding the grain and supporting the stone."

35. For an *Improvement in Machines for Ditching;* Ralph C. Pratt, Canandaigua, New York.

*Claim.*—"What I claim is, the ditching machine, consisting of a beam and casing, or their equivalents, in one or more parts, with a cutting and scraping point, hung on the shaft of a revolving wheel, with shovels attached to the outer circle of the wheel, which self act by turning the wheel and forming a bucket, in connexion with the casing, so as to carry up the earth to the inclined slides, the whole being operated and constructed substantially as herein described."

36. For an *Improvement in Lining for Fire Proof Safes;* John Farrel, Philadelphia, Pennsylvania.

"The nature of my invention consists in the introduction of flour, grain, or other vegetable substances into the space which in such safes is usually filled with non-conducting materials. I have found it useful to combine with them lime, cement, or other similar and well known materials, usually employed to give a set and hardened character."

*Claim.*—"What I claim is, the application and use of flour, grain, maize, starch, or other vegetable substance of a like nature, either alone or in combination with lime, cement, or similar substances, in the construction of fire proof chests or safes, substantially as described."

37. For an *Improvement in Gripes for Holding Leather;* Bradford Rowe, Albany, New York.

*Claim.*—"I claim the construction of a gripe composed of a key, turning within a socket or chamber, the key being a solid cylinder, with a portion of its surface cut away in two faces parallel with its axis, and at an angle with each other, one face being grooved lengthwise, and the chamber being a hollow cylinder, with a portion of its space filled up parallel with its axis, and having a longitudinal slit through it for nearly its whole length, corresponding with the cut away part of the key, so that when the key is in the chamber, a strap of leather or other material can pass through the chamber and under the key, as described."

38. For an *Improvement in Grain Winnowers;* George B. Salmon, Elmira, New York; ante-dated, July 6th, 1853.

"The nature of my invention consists in cleaning and separating grain by means of a blast spout screen and troughs, arranged in a manner which will be hereafter described, by which the grain is perfectly separated from the improper substances which are usually mixed with it previous to being separated, and the grain, as well as the different sorts of improper substances, conveyed to separate places, and kept distinct or separate from each other."

*Claim.*—"I do not claim the blast head, or the blast spout B, separately; neither do I claim the screen F, nor the trough and spouts MM, separately." "But what I do claim is, 1st, The expansion of the upper part of the blast spout B, into the circular irregular enlarged head, with an opening or mouth at the lower extremity, partly covered with the sieve E, for the purpose of allowing the force of the blast to be exhausted, the screenings immediately falling through the opening or mouth of the head while the blast and dust escape through the screen E, the blast being governed by a slide, substantially as fully set forth and described. 2d, I claim the arrangement and construction of the graduated sieve (*a b*,) of unequal fineness, the portion *a*, being protected from the action of the fan blast, so that the small substances, such as cockle, &c., passing through and falling on the bottom board of the sieve *a*, passes off at the trough and spouts MM; and when the grain arrives at the coarser part of the sieve *b*, it passes through and is acted upon by the fan blast, while larger substances than wheat pass over the end of the sieve *b*, and fall on the floor, substantially as set forth."

39. For an *Improvement in Ovens;* Ephraim Treadwell, City of New York.

*Claim.*—"What I claim is, the use of a perpetual oven, having side doors in it, for charging and discharging it, at intermediate points between the ends of the oven, in combination with the upper and lower independent heating flues and furnaces, for directing the entire heat from one set of furnaces through flues on the upper side of the article to be baked, and the entire heat from the other independent set of furnaces through flues on the under side of the article to be baked, substantially as set forth."

40. For an *Improvement in Compressers for Flyers;* William H. Thompson and Richard H. Plummer, Biddeford, Maine.

*Claim.*—"We claim the combination of the guard rib *e*, with the hole *a*, and the passage *b*, and the opening *d*, substantially in manner and for the purposes as specified."

41. For an *Improvement in Spike Machines;* Philip P. Trayser, Baltimore, Maryland.

*Claim.*—"What I claim is, the combination with the knife which severs the blank from the rod, of two stumps, either or both moving, whereby while one blank is being headed and pointed in the dies, the end of the rod for the next blank is cut off and bent preparatory to forming a head, substantially as described. I also claim the method of heating spikes by bending the end of the rod, preparatory to upsetting, before placing it in contact with the heading dies, instead of giving it the preparatory bending while in contact with the dies, and therefore heats them less, while at the same time it is not detained longer than usual out of the dies, so that by this method the dies are better protected from excessive heating, the rod from cooling, and the whole operation expedited and improved, substantially as set forth."

42. For an *Improvement in Mounting Spirit Levels;* Sylvester I. Sherman, City of New York.

*Claim.*—"What I claim is, the spring catch for holding the level in place upon the square or ruler, in combination with the bearers, the latter being so formed with respect to the level, that when they are placed upon a horizontal line, the bubble will be in the middle of the glass, and thus a horizontal or a vertical line may be ascertained from a ruler, or from a square, when said level is attached, substantially as set forth."

43. For an *Improvement in the Manufacture of Wigs;* Thomas C. Weildon, Hartford, Connecticut.

"The nature of my invention consists in the method of fastening and attaching the hair with a gluten to the frame work, body, or net work, of wigs, toupees, bands, braids, curls, &c., or any other kind of hair-work, now in use or that may be in use hereafter."

*Claim.*—"What I claim is, the method of fastening and attaching the hair to wigs,

toupees, or any other kind of hair work, by means of any kind of glutinous substance, substantially in the manner and for the purpose substantially as described."

44. For an *Improvement in the Preparation of Bristles for Brushes;* Charles Williams, Philadelphia, Pennsylvania.

"The nature of my invention consists in the mode of preparing the bristles by the application of heat (by steam or otherwise) to the roots of the bristles."

*Claim.*—"What I claim as new in the manufacture of that class of brushes known as "drove work," is preparing the bristles by application of heat to the roots, substantially in the manner and for the purpose which I have set forth."

45. For an *Improvement in Gutta Percha Stereotype Compositions;* Leonardo Westbrook, City of New York.

*Claim.*—"What I claim as my invention and improvement, on the patent of Josiah Warren, dated April 25th, 1846, is, 1st, The compound herein described of shellac, plumbago or graphite, asphaltum, and gutta percha, treated by sulphate of copper and water, in the manner described, as a substitute for type metal."

46. For an *Improvement in Air Engines;* Austin O. Willcox, Philadelphia, Penn.

*Claim.*—"Having thus fully described my improved caloric air engine, what I claim is, the interchanging circulators, situated within, and occupying one half of the capacity of each heat reversing vessel, and so arranged as to alternately transfer the air or other fluid to the heating and cooling divisions of said vessels; in the same movement to cause the air to pass through renovating plates, or their equivalent, whether placed within the circulators and transmitting the air, or placed without the circulators and the air forced through them, substantially as herein described. I also claim, placing an inwardly pressing packing, in the open end of each working cylinder, and in combination therewith, the construction of the working piston (being of the requisite length) of a little less diameter than the interior of the cylinders; whereby the friction surface is confined to the periphery of the piston, in order to sufficiently exclude its lubricating fluid from the contact of the hot air within the cylinders, substantially in the manner herein set forth." "I also claim the barrel and stationary hollow piston, with its supply tube, aperture, and valves, in combination with the working piston and its valves, for the purpose of supplying air or other fluid to the cylinders, when desired, substantially as herein described."

47. For an *Improvement in Paper Cutting Machines;* Frederick Hesse, Assignor to H. J. Oerter, Bethlehem, Pennsylvania.

"The nature of my invention consists in having an adjustable knife or cutter, placed within a sliding stock, and so arranged, that said knife or cutter may be regulated to cut the required depth, by merely turning the handles by which the sliding stock is moved upon the bed."

*Claim.*—"I do not claim a stock provided with a knife or cutter working on a bed piece, irrespective of the employment and arrangement of the rack bar and pinion, as that has been previously used." "But what I claim is, cutting paper, pasteboard, or other articles, by means of a knife or cutter, attached to a rack bar, which mashes into a pinion, said pinion being hung or attached to a spindle or shaft, to the ends of which the handles of the sliding stock are secured; the above parts being attached to the sliding stock, by which device the knife or cutter may be elevated or depressed, as desired by the operator, while working the sliding stock upon the bed piece, as set forth."

JULY 26.

48. For an *Improvement in Shower Bath Tables;* Cyrus C. Bisbee, Rochester, N. Y.

"My improvements consist in the construction and arrangement of a shower bath, in such a manner that, when not in actual use as a bath, it may be converted into a table, adapted to the common uses of such an article of furniture."

*Claim.*—"What I claim is, the combination of the upper and lower tray, substantially as herein described, so that they shall simultaneously recede from each other to elevate the water and set up the bath, and approach each other to pack away the bath and convert the apparatus into a table."

49. For an *Improvement in Rotary Steam Engines;* Richard C. Bristol, Chicago, Ill.

*Claim.*—"What I claim is, the combination and arrangement of the outward radiating pistons, or their equivalents, with the sliders, steam-ways or passages, and abutments, in

such manner that the sliders are free from lateral friction by pressure of the propelling medium in passing the abutments, and are worked outwards and kept up to their bearing by the pistons, substantially as specified, whereby promptness and certainty is insured in the outward action of the sliders, counteracting pressure to their inward radiation removed, and a tight but free action of the sliders through their entire travel produced, essentially as set forth."

50. For an *Improvement in Ploughs;* Wm. V. Burton, Orange, Ohio.

*Claim.*—"What I claim is, 1st, the manner of securing the points of the land side, land cutter, and counter side, by the lock couplings or joint, formed in the mortise by the curvature of the tenons, as herein set forth. 2d, The plough point, and a reversible land side piece, in the manner specified, whereby the land side piece and point are made reversible."

51. For an *Improvement in Mills for Grinding Apples and other Substances;* F. B. Hunt, Westfield, Indiana.

*Claim.*—"I do not claim the employment of the endless belts, irrespective of their arrangement, as they have been long used; neither do I claim the cutters nor cylinder press separately; but what I claim is, 1st, the employment or use of the endless belts, arranged as described, viz: the upper belt, having an adjustable roller, which, upon being elevated or depressed, causes the belts at the discharge ends to be brought nearer together, or separated further apart, thus allowing the belts to be adjusted, to feed or convey to the cutter all the different articles or substances which at present require each a separate and distinct machine. 2d, I claim, in combination with the two endless belts arranged as described, one or more cutters or cutting cylinders; said cylinders being placed loosely on their axes, and secured by set screws, as herein described, by which several forms of cutters may be used, according to the work required to be performed."

52. For an *Improvement in Processes for Making Glue;* David A. James, Cincinnati, Ohio.

*Claim.*—"1st, The method substantially as described, of preservation and conversion into glue, of the tanners' scraps, &c., by open piling successive layers of scrap, coated by cream of lime, (in place of the lime steeping heretofore resorted to,) followed by the application of sulphuric or other suitable acid, which, combining with the lime, prevents the deleterious action on the glue, and supersedes the necessity of the atmospheric exposure now resorted to. 2d, The combination with the said previous treatment, the process substantially as described, of making glue by means of the combination of direct and indirect steam, acting in concert, or separately, according to the stage of the process, and the relative heat and moisture required, avoiding on the one hand, the injurious scorching effects of the open furnace, and on the other hand, the serious inconvenience of undue dilution by the open steam jet."

53. For an *Improvement in Lamps;* Owen Redmond, Rochester, New York.

*Claim.*—"What I claim is, resting the oil fountain for lamps upon a spring or springs, so constructed as to retain the surface of the oil in the fountain constantly at a nearly uniform height; and this I claim, whether used with or without a float, as above described and set forth."

54. For an *Improvement in Seed Planters;* Milton Satterlie, Louisa, Illinois.

*Claim.*—"What I claim is, the arrangement of the drill and covering wheels, or their equivalents, on flexible axles, so that the said wheels, or their substitute, will rise and fall to accommodate themselves to undulating ground, whereby the grain in all the furrows is planted at an equal depth and equally covered, substantially as specified."

55. For an *Improvement in Railroad Car Seats;* Wm. M. Warren, Watertown, Conn.

"The nature of my invention consists in attaching the hinged back to the stationary back, in such a manner that the seat will be inclined as the hinged back is raised and brought to a horizontal position, when the hinged back is depressed and placed against the stationary back."

*Claim.*—"I do not claim a rotating seat, for they have been previously used; but what I claim is, attaching the hinged or adjustable back to the stationary back, by means of the hinges, *b b*, and having a jointed or hinged metal strip, *c*, secured to the adjustable back, and to the cross-piece; the hinge or joint, *d*, of the metal strip being above the line of the

hinges, *b b;* by which arrangement the seat is inclined, or brought to a horizontal position, as the adjustable back is raised or depressed, as shown and described."

56. For an *Improvement in Bran Dusters;* Ezra R. Benton, Cleveland, Ohio.

*Claim.*—"I am aware that in a bran duster, patented February 27th, 1849, a fan with oblique wings is employed at the top of the machine for producing a draft of air into the same, and a fan with wings parallel with the axis of the cylinder is employed at the bottom of the machine, for sweeping the bran from the bottom of the machine into a lateral opening in the side of the same; and therefore, I wish it to be understood that I do not claim the said arrangement and character of fans in a bran duster, as in my invention; but what I do claim is, the combination of the two inwardly acting drafts of air of different degrees of strength, produced by the oblique fans when their forces are proportioned in such a manner that the upper blast will feed the bran into the machine and drive the flour through the sieve, while the lower current only counteracts the downward pressure of the upper blast, so as to prevent any flour from falling to and being discharged with the bran at the aperture in the bottom of the duster, substantially as described."

57. For an *Improvement in Corn Planters;* Jacob H. Carothers, Davidsburgh, Penna.

*Claim.*—"What I claim is, the method of stopping the seeding apparatus by grappling the periphery of the driving wheel, in the manner herein described."

58. For *an Improvement in Bee Hives;* Sylvester Davis, Claremont, New Hampshire.

*Claim.*—"What I claim is, the manner of constructing the float, viz: of two parallel series of slightly separated thin slats, placed one directly over the other, and separated by two or three cross slats, and supported by similar cross slats beneath the whole, for the purpose of allowing the bees to feed without being liable to be mixed in the food beneath."

59. For an *Improvement in the Beaters of Smut Machines;* Ziba Durkee, Alden, N. Y.

*Claim.*—"I am aware that the concave in smut machines has been made of wire netting, but as this remains stationary, it does not become so much worn by use, nor does it perform so active a part in the beating and scouring of the grain as the revolving cylinder; this I do not claim; neither do I claim a revolving wire cloth cylinder; but what I do claim is, the covering of the revolving cylinder, wings, or beaters of smut machines with wire netting or cloth, for the purpose of providing an uneven but smooth beating or rubbing surface, and at the same time give great durability to the said parts, substantially as described."

60. For an *Improvement in Omnibus Lanterns;* F. O. Deschamps, Philadelphia, Pa.

*Claim.*—"What I claim is, constructing the case of the lamp in the manner substantially as described, viz: the lower part of the case being constructed of glass, and the upper part of metal, having a lens inserted in it, by which construction the lamp, when placed as herein shown, is made to illuminate the interior of the omnibus, or stage, and also to afford light on the top or roof of the omnibus or stage, to enable the driver to see distinctly what money or ticket he may receive, and to facilitate him in giving change."

61. For an *Improvement in Covering the Backs of Books;* John A. Elder, Westbrook, Maine.

*Claim.*—"What I claim is, 1st, hanging the frame carrying the pressure roller upon, and eccentrically to the centre of motion of the arms, so that the centre of motion of the frame can be raised at pleasure, in the manner and for the purposes described. 2d, The combination of the wedge and bars, when connected with the jaws of the clamps, as described, for the purpose of keeping the centre of the book, whatever its thickness, vertical with the bearings of the swinging frame, as described and set forth."

62. For an *Improvement in Dyeing Yarn Parti-Colored;* Daniel B. Hinman, Philadelphia, Pennsylvania.

*Claim.*—"What I claim is, the employment of series of separate and adjustable or changeable bars, one above the other, in an adjustable press, and pressing between their faces the parts of the yarn not intended to be dyed, while the liquor is in contact with and dyes the parts of the yarn between the sides of the bars, substantially as described."

63. For an *Improved Plotting Theodolite;* Levi Pitman, Tom's Brook, Virginia.

*Claim.*—"What I claim is, 1st, the adjusting index, or its equivalent, in combination with the graduated scale upon the traversing ruler, and the horizontal dial, substantially as described. I do not claim a rotating drafting board turning upon a fixed centre pin in

a protracting arch, with a traversing ruler working upon two graduated parallel guide strips, such as have been used heretofore; but what I do claim is, a dial, such as is herein described, fixed upon a staff or socket, in combination with the revolving frame, (turning under said dial on the socket,) and carrying the traversing ruler, and a suitable sight vane, constructed and operating as described."

64. For an *Improvement in Straining Saws by Compressed Air;* Jackson A. Rapp and Edward S. Wright, Buffalo, New York.

"The nature of our invention consists in the application of compressed air, so applied to piston heads working in cylinders at each end of the saw, and to which heads the saw is connected by its ends by rods, as that the tendency of the compressed air to push or pull apart the piston heads, shall be exerted to the straining of the saw, and thus keep it perfectly strained without the use of a gate or saw frame."

*Claim.*—"What we claim is, the application of compressed air to the straining cylinders of saws, when said cylinders are so connected with each other that the compressed air shall alternately pass from one cylinder to the other, during the reciprocating action of the saw, and combined with the air pump and pressure valve, for the purpose of regulating and maintaining the intensity of the steam on the saw, substantially in the manner described."

65. For an *Improvement in Dyeing Compounds;* Frederick G. Vettercke, City of New York.

*Claim.*—"What I claim is, the making of the kali compound, substantially as herein set forth, as a basis for a blue dye."

66. For an *Improvement in Preserving India Rubber in the Liquid State;* Henry Lee Norris, Assignor to Samuel T. Armstrong, City of New York; patented in England, February 24, 1853, and in France, March 13, 1853.

"The nature of my invention consists in treating the milk or juice drawn from the caoutchouc, or india rubber tree, so as to form a compound which remains liquid, and is prevented from fermentation, acidulation, coagulation, or becoming putrid, and which can therefore be transported to remote places without decomposition or deterioration; and also, in so treating this composition as to produce therefrom a new and useful article of manufacture."

*Claim.*—"What I claim is, the compound, consisting of the native juice of the caoutchouc, with aqua ammonia, or the equivalent thereof, substantially as herein set forth, when said ammonia, or its equivalent, is mixed with said juice of the caoutchouc in a liquid state, by means of which the juice above named is preserved for a great length of time, and can be manufactured at less expense than the india rubber of commerce, which is mixed with other foreign substances. And I also claim the solid elastic article when manufactured from the said composition of matter, as above described."

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### Re-issues for July, 1853.

1. For an *Improvement in the Process of Flouring;* David P. Bonnell, Tecumseh, Michigan; patented August 14, 1849; re-issued July 5, 1853.

*Claim.*—"What I claim is, the process of grinding the offal of grain immediately after it has passed from the bolts, contemporaneous with the first flouring, and by the continuous operation of machinery adapted to said process, substantially as set forth, for the purpose of increasing the quantity and improving the quality of the superfine, or other flour."

2. For an *Improvement in Composition for Stereotype Plates;* Leonardo Westbrook, City of New York, Assignee of Josiah Warren, Posey, Indiana; patented April 25, 1846; re-issued July 26, 1853.

*Claim.*—"What I claim is, 1st, The mixture (herein described) of shellac, tar, and sand, as a substitute for type metal. 2d, The use of shellac as a basis to form a substitute for type metal, when it be mixed with the substances I have mentioned, or with other substances of a similar nature. 3d, The use of clay mixed with sand in various proportions; also, with gum arabic, beeswax, stearine tallow and oil, as before described, for the purpose of engraving or forming matrices or moulds, in which to make casts for typographical purposes, of the material and in the manner substantially set forth. 4th, The use of clay as a basis from which to form matrices or moulds, as aforesaid, whether it be mixed with the materials I have mentioned, or whether other substances be used instead of them, but substantially of the same nature. 5th, I claim, in combination with the employment of plastic

material for stereotyping, the employment of the bearers, in the manner described, for the purpose of obtaining casts exactly level and of type height."

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DESIGNS FOR JULY, 1853.

1. For a *Waffle Baker;* Nathaniel Waterman, Boston, Massachusetts, July 5.

*Claim.*—"I claim the design for the waffle plate, or mould, substantially as exhibited in the drawings."

2. For a *Cook Stove;* Samuel Pierce and James J. Dulley, Assignors to Johnson, Cox, & Fuller, Troy, New York, July 12.

*Claim.*—"We claim the ornamental design and configuration of cook stove plates, such as described and represented."

3. For a *Cooking Stove;* John Mason, Assignor to Hight Street Furnace Company, Providence, Rhode Island, July 19.

*Claim.*—"The new design, consisting of the flower work and ornamental figures composed of raised leaves and spear heads, described and represented, for the front, side, and back plates of a cooking stove."

4. For a *Cooking Stove;* Johnson, Cox & Fuller, Assignees of James J. Dulley, Troy, New York, July 19.

*Claim.*—"I claim the ornamental design and configuration of cook stove, such as described and represented."

5. For a *Sewing Bird;* Julius E. Merriman, Meriden, Connecticut, July 26.

*Claim.*—"I claim the design and configuration of the sewing bird at rest, as described and represented."

6. For a *Parlor Stove;* Elihu Smith, Albany, New York, July 26.

*Claim.*—"I claim the combination and arrangement of ornamental figures and forms represented."

7. For a *Stove;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, July 26.

*Claim.*—"I claim the combination and arrangement of the ornamental forms and configurations represented, forming an ornamental design for a stove, as described."

8. For a *Cooking Stove;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, July 26.

*Claim.*—"What I claim is, the combination and arrangement of the ornamental forms and configurations of a cooking stove, as described."

9. For a *Cooking Stove;* Thos. Barry, City of New York, Assignor to North, Chase & North, Philadelphia, Pennsylvania, July 26.

*Claim.*—"What I claim is, the design and configuration of the mouldings and ornamental work, as herein described."

10. For a *Cooking Range;* Reuben H. N. Bates, Providence, Rhode Island, Assignor to North, Chase & North, Philadelphia, Pennsylvania, July 26.

*Claim.*—"What I claim is, the design and configuration of the moulding and ornamental work, as herein described."

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AUGUST 2.

1. For an *Improvement in Reed Musical Instruments;* James A. Bazin, Canton, Mass.

*Claim.*—"What I claim in the construction of organs, reed, and other similar instruments of music, is, 1st, Flatting the thirds, sixths, and sevenths of the scale, by means of the regulating cylinder, constructed as described, or by any other analogous contrivance, in the manner and for the purpose substantially as set forth. 2d, The valve constructed as described of the two parts *s* and *o*, with the springs *u* and *v*, or their equivalents, in combination with the perforated plate, for the purpose of sounding the note flat or sharp, as set forth. 3d, The combination and arrangement of the sliding bar, the buttons, the bent wires, by which means the key board may be locked and moved in either direction by one

hand, in the manner set forth. 4th, The use of two or more wind chests in the same instrument, for the purpose of providing a separate supply of air for the bass and treble notes, as herein set forth. 5th, The peculiar arrangement of the bellows and wind chests; the latter being placed below the former, and communicating with the reed box, by means of flexible passages passing up through the bellows, as described; which arrangement of parts enables me to make use of two wind chests, in the manner and for the purpose set forth. 6th, Hanging the pedal with a movable fulcrum, to prevent friction upon the foot, and to enable it to be operated with more ease and convenience, as set forth. 7th, The construction and arrangement of the air passages above and below the reed, as described, for the purpose of admitting the air, and permitting it to escape at the but end of the reed, as set forth. 8th, The presser bar, so constructed and arranged as to keep down the rear portion of all the valves, while their front portion is left free to be operated by their keys, thereby modifying the tone of all the notes of the instrument, as set forth."

2. For an *Improvement in Seed Planters;* George W. Brown, Tylerville, Illinois; antedated February 2, 1853.

*Claim.*—"What I claim is, 1st, The oscillating horizontal wheels, or distributors, in the bottom of the hoppers, having slots and holes of various sizes, in combination with the stationary caps and pins, for the discharge of different kinds and quantities of seeds, as set forth. 2d, The arrangement of the covering rollers, mounted as described, and performing the purpose of covering the seed, elevating the cutters in turning around, and also in adjusting them to different depths, as set forth."

3. For an *Improvement in Seed Planters;* Lebbeus Caswell, Harrison, Maine.

*Claim.*—"What I claim is, placing the axle of the gauge wheels on a fulcrum in an adjustable slide, as above described, so as to plant at any desired and at the same time a uniform depth, as above set forth."

4. For *Apparatus to Regulate the Supply of Water to Steam Boilers;* Samuel R. Clime, District of Spring Garden, Pennsylvania.

*Claim.*—"What I claim are, the water chambers, as described, and the contrivance and machinery by which their action is aided and facilitated.

5. For an *Improvement in Abdominal Supporters;* A. B. Conant, Geneva, Wisconsin.

*Claim.*—"What I claim is, constructing it with two encompassing springs, attached respectively at their centres to the front and hind pads, (the hind spring being slightly curved upwards in the middle, and the front spring correspondingly curved downward, and both springs straight on their flat sides, as described;) and uniting said springs at their adjacent ends with straps of adjustable lengths, whereby its pressure may be varied at pleasure, and the same supporter worn by persons of different sizes, substantially as set forth."

6. For an *Improvement in Railroad Car Wheels;* Thomas J. Eddy, Waterford, New York.

*Claim.*—"What I claim is, a cast iron car wheel, made in one piece, in which one end of the hub is united to the rim by means of a disk, and the other by means of a series of spokes, substantially as set forth."

7. For an *Improvement in a Paper Ruling Machine;* C. S. Boynton, City of New York.

*Claim.*—"I do not claim the endless apron, nor any particular manner of operating it, for they are now employed in ruling machines. But what I claim is, 1st, The employment or use of the guides, by which the paper may be properly adjusted upon the apron and fed underneath the pens. 2d, The guides or stops attached to the selvedge of the endless apron, for the purpose of elevating the pens from the paper at required distances, according as the guides or stops are adjusted upon the apron, and thereby causing the paper to be ruled in lines of the desired length, and having the requisite spaces between them, as described."

8. For an *Improvement in Submarine Tunnels;* Joseph R. Miller, Jersey City, New Jersey.

*Claim.*—"What I claim is, constructing submarine avenues, by casting them in short manageable sections, sinking each successively to its place, and uniting their ends successively by means of flanches, bolts, and packing, substantially as described, when these are combined with a lip or lips with the end of each section, to ensure the bolt holes and other corresponding parts to come and rest opposite to each other, as each succeeding section is sunk to its place, and when the structure is made to rest upon a graded bot-

tom, as the work progresses, and is held thereto, by superincumbent weight, when completed. I do not claim any one or any number of the elements above specified, except in combination with all the others; nor when used for any other purpose than that specified."

9. For an *Improvement in Temples for Looms;* Joseph A. Scholfield, Westerly, R. I.

*Claim.*—"What I claim is, the application of a stationary spur plate to the temple, with the pins in said plate inclined at an angle to the breast beam, so as to allow the cloth to be drawn over the tops of said pins, as the lay beats up, and from their inclination preventing the cloth from receding during the backward motion of the lay, in the manner and for the purpose described."

10. For an *Improvement in the Construction of Steam Boilers;* John M. Reeder, Memphis, Tennessee.

*Claim.*—"What I claim is, the application to steam boilers, of a stem, valves, and the mode of their operation, which will at any given pressure allow the water in the boilers to pass freely on the fire under them, thereby retaining the steam, and prevent explosion, as described."

11. For an *Improvement in Machines for Making Spikes;* John R. Richardson, James Waterman, and Ebenezer Wilder, New Castle, Pennsylvania.

*Claim.*—"We do not claim any peculiarity of the jaws, nor the manner in which the movable jaw is operated; for these are well known devices, and have been previously employed; but what we claim is, 1st, The manner of forming the point of the spike, substantially as herein shown and described, viz: by means of the combination of the wide dies resting on the disks of the rollers, and the pointing rollers, arranged and operating substantially as set forth. 2d, We claim slightly withdrawing the header, after the head is completed, for the purpose of relieving the jaws from its pressure, before they begin to open, and holding it in that position, with the spike head therein, until the jaws are opened and the movable jaw and die are nearly or quite withdrawn from the spike, then withdrawing the header to its farthest position from the dies, allowing the spike to fall; thus causing the header to perform the duty of a clearer, substantially as described. 3d, We claim the combination of the cutting guide loop, the cutter, and the holder, as constructed, and operating with the movable jaw and movable die, for the purpose of cutting off the blank at sufficient distance from the ends of the dies, to leave material for the head, and carrying it over to the stationary jaw, at the same operation, substantially as described. 4th, We also claim attaching the gauge firmly to the carriage of the pointing rollers, so that it will be withdrawn as the point is drawn out by the rollers, and returned to its position when the pointers are withdrawn, without any other mechanism to actuate it, as described."

12. For an *Improvement in Atmospheric Telegraph and Railway;* Ithiel S. Richardson, Boston, Massachusetts; patented in England, December 7, 1852.

*Claim.*—"What I claim is, 1st, The check plate, consisting of three pieces; two being stationary, and the third or middle one revolving between them, air tight, constructed as described, or in any manner substantially the same, and for the purpose set forth. 2d, The turn table, constructed as described, of the ring w, and its station box, in combination with the rings r and v, or their equivalents, as herein set forth. 3d, The method of announcing the arrival of the plunger, by means of the compression of the air within the cylinder, at the instant of the arrival of the plunger, operating through the orifice in the cylinder, the valve *g*, and the hammer *t*, as described, or in any other manner substantially equivalent thereto; the compressed air being the agent. 4th, And lastly, I claim the combination of the pendant lever *e'*, with the valve *f'*, and spring *o'*, or analogous devices, by which means the valve is drawn up to its seat, when no longer kept open, by the pressure of the atmosphere, and firmly locked in that position, until the lever is again tripped, by the passing plunger or load."

13. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts; ante-dated February 2, 1853.

*Claim.*—"What I claim is, the combination of the adjustable gauge with the diverging springs, for catching and guiding the edge of the sheet when it is sliding to its position, substantially as described."

14. For an *Improved Mode of Indicating the Height of Water in Steam Boilers;* Nathan Thompson, Jr., Williamsburgh, New York.

*Claim.*—"I wish it to be distinctly understood, that I do not claim either floats, or valves, or chambers, or levers, as of my invention, knowing that they are well known and common property; neither do I claim the combination of a float within a boiler, with indicators or alarms, in the general. But what I do claim is, the method substantially as herein described, of slowing and stopping the main engine, by means of a float, or its equivalent, which is governed, in its position, by the height of the water in the boiler; whereby I am enabled to furnish a reliable and not to be disregarded intimation of the level of the water in the boiler. Secondly, I claim a hook and pin, or their equivalents, in combination with a boiler float, whereby said float is prevented from acting during ordinary fluctuations of the water level, substantially in the manner and for the purposes herein specified."

15. For an *Improvement in Machinery for Making Railroad Chairs;* William Van Anden, Poughkeepsie, New York.

*Claim.*—"What I claim is, 1st, The combination of rollers with adjustable shear stocks for cutting and shaping the lips of wrought iron railroad chairs, substantially as set forth; and their combination with the dies for that purpose. I also claim the use of a movable drop upper half or female die, in combination with a stock, substantially as set forth, and their combination with the discharging apparatus, operated substantially as set forth. I also claim the use of adjustable and removable benders, in bender stocks, in combination with the levers and cams, on the main shaft, for operating the same, in an oblique and downward direction, and their combination with the dies and cutters, for making wrought iron railroad chairs."

16. For an *Improved Mode of Obviating the Danger from Steam Boiler Explosions;* Stephen Waterman, Williamsburgh, New York.

*Claim.*—"I do not confine myself to placing the cold water reservoir on the top of the safety chamber, as it may be placed in other positions; and instead of communicating with the safety chamber, may communicate with the steam space of the boiler. Nor do I confine myself to the particular mechanical means, by which the tearing apart of the safety plate is made to open the communications between the water reservoir and the boiler and safety chamber. But what I claim is, the combination with the safety chamber and safety plate of a cold water reservoir, which has means of communication at the lower part with the safety chamber or steam space in the boiler, and at the upper part with the steam space in the boiler; which said means of communication are closed when the boiler is in proper operation, by cocks, or their equivalents, which are caused to open by the tearing apart of the safety plate, in any manner substantially as described, for producing the effect herein fully set forth."

17. For an *Improved Arrangement of Pipes for Hot Blast Furnaces;* Jesse Young, Franklin Furnace, Ohio.

*Claim.*—"What I claim is, the arrangement of a series of angular, horizontal pipes, short vertical connecting pipes, which also serve as supports or pedestal, and a hollow base, through which the cold air passes into the pipes, and upon which hollow base the pipes rest, by which arrangement the air is made to pass slowly through the pipes and base, and is exposed a sufficient length of time to the action of the heat to become heated with a small expenditure of fuel."

18. For an *Improvement in Hot Air Engines;* Austin O. Willcox, Philadelphia, Pennsylvania.

*Claim.*—"I do not claim the use of renovating disks, outside of the working cylinder, either when alternately traveling through the heated and cold air, or when stationary, and alternately transmitting heated and cold air, as I am aware such have been before used. But what I do claim is, placing the economizing disks within or attaching them to the driving piston itself, whereby I am enabled to effect the complete rarefaction of the heated air, while the piston is descending, and before the cold air is again let into the cylinder, substantially in the manner and for the purposes herein described. I also claim enclosing the exhaust end of each single acting working cylinder, with an air-tight head, when combined with a self-acting valve, which opens from said exhaust end of the cylinder into the eduction pipe, in order to exclude the external atmosphere; and also for the double purpose of enabling any degree of rarefaction to take place within the exhaust end of the

cylinder, without the return of air from the reservoir, and to allow the spent air, finally, to escape to said reservoir, substantially as herein set forth. I also claim enclosing each working cylinder within a jacket, (of any suitable material,) regularly increasing in thickness, from the bottom to the top, in such a manner, that when it is surrounded by water, or other fluid, the temperature of the working cylinder will be kept reduced to a proper and nearly uniform degree, (without much waste of heat,) so as not to injure the lubricating fluid inside; whereby I am enabled to apply the heat of the furnace immediately under said cylinder, thus obviating the use of an expansion heater, substantially as herein described."

19. For an *Improvement in the Manufacture of Paper Stuff;* Jean Theodore Coupier and Marie Amedee Charles Melliér, Paris, France; patented in France, May 7, 1851.

*Claim.*—"We do not claim as our invention, the use of alkalies in the treatment of vegetable fibre for the preparation of paper pulp; nor do we claim the individual parts of the apparatus employed in our process; but what we do claim is, 1st, the process herein described, of reducing straw and other similar vegetable matters into pulp for making paper, said process consisting in applying and circulating the solution of the hydrate of soda or potash, in the manner above mentioned, and at or about the strength indicated, in combination with the apparatus, substantially as described, by which means we are enabled to effect the reduction of a very large amount of pulp, with a comparatively small quantity of liquor, and preserve, also, the requisite strength in the liquor, and also obtain facility for its evaporation. We do not claim the use of hypochlorites, for bleaching pulp; but what we do, secondly, claim is, the employment of hypochlorites in the process of bleaching straw, or similar vegetable matter, when prepared as above, for the purpose of making paper, substantially as herein set forth, that is to say, using them at or about the strength set forth in the specification, viz. 3° Baume, and we claim this degree of strength only when employed upon such materials."

20. For an *Improvement in Elastic Type for Printing on Irregular Surfaces;* Julius Herriet, City of New York, Assignor to J. Gaylord Wells, Hartford, Connecticut.

*Claim.*—"What I claim is, making by casting in moulds, or by pressure plates, with raised characters or figures, the entire substance of such plates being sufficiently elastic as to adapt it to printing, substantially as described."

21. For an *Improvement in Anti-Friction Boxes;* George T. Parry, Spring Garden, Assignor to John Rice, Philadelphia, Pennsylvania.

*Claim.*—"I do not claim as my invention the employment of conical rollers, traveling around in grooves, as a means of reducing friction on the ends of shafts, and under turning platforms, when the rollers are in the form of single frustrums; as this has long been known. But what I do claim is, making the rollers in the form of double frustrums reversed and united at their bases, and traveling in circular grooves of nearly corresponding form of the surfaces between which the rollers are interposed, substantially in the manner and for the purpose herein specified."

## AUGUST 9.

22. For an *Improvement in Winnowers of Grain;* Samuel Canby, Ellicott's Mills, Md.

*Claim.*—"What I claim is, the construction of the receiving and discharging passages for the grain; that is, the passage at door, P, passage, c, and passage, c″, in the manner and for the purpose as set forth."

23. For an *Improvement in Multiplying Gearing;* Frank Dibben and Lewis Bollman, City of New York.

"The nature of this invention consists in transmitting rotary motion by means of the difference of proportion between two pairs of toothed wheels, or their equivalents, two of the wheels, viz: one of each pair having a common fixed axis, and the other two wheels gearing into them having a common axis which is capable of revolving round the said fixed axis. By the difference of proportion between the two pairs of wheels, we mean the difference between the proportion that the circumference of the two wheels of one pair bear to each other, and the proportion that the circumference of the two wheels of the other pair bear to each other."

*Claim.*—"What I claim is, the employment in any manner substantially as described for the purpose of transmitting rotary motion, at a multiplied or decreased speed, of two pairs of toothed or friction wheels, combined and arranged as described, to wit; the said wheels being placed upon two axes, one of which is capable of revolving round the other;

one wheel of each pair being on the axis *e*, and the other wheel of each pair being placed upon the axis *f*, as herein set forth."

24. For an *Improvement in Life Boats;* Daniel Dodge, City of New York, and Phineas Burgess, East Boston, Massachusetts.

*Claim.*—"We do not claim to have invented a boat having an opening extending completely through it, whereby it is rendered, by the addition of a floor, fit for service in opposite positions on the water; but what we do claim is, the central fixed platform, which is secured in the opening of the boat, in a plane passing centrally and horizontally, or nearly so, through the same, or which may be said to form a partition between two opposite recesses, substantially as described, the said platform serving as a floor to the boat, whichever side is upwards, and being from its fixed position, incapable of becoming disarranged by any accident."

25. For an *Improvement in Setting up Ten Pins and Returning Balls;* George W. Eichell, City of New York.

*Claim.*—"I do not claim the elevator *n*, nor any particular elevator; neither do I claim setting up the pins by a weight or weights; nor do I intend to claim the setting up of the pins from the head of the table; but what I do claim is, setting up the pins of an alley by an apparatus, operated from the head of the table or elsewhere, by means of a weight or weights attached to them by cords, when combined with the elevation board, which raises and sustains the weight or weights, to admit of the pins being knocked down, as herein described. I also claim the use at the back end of the table of a delivery board, applied and constructed as described, in combination with an elevator for the elevation and return of the balls, substantially as described."

26. For an *Improvement in Carpenter's Clamps;* Benjamin H. Green, Princeton, New Jersey.

*Claim.*—"What I claim is, the combination of the adjustable vibratory arms, and reversible jaws, with the adjustable clamp, for the purpose of presenting jaws of different sizes and at different distances from each other, substantially in the manner herein set forth."

27. For an *Improved Mode of Drying Paper;* John Hartin, City of New York.

*Claim.*—"What I claim is, drying paper by passing it between opposite series of equal sized fans, which revolve with equal velocities; by which a pressure of air of equal force is made to act simultaneously upon opposite sides of the paper, and thereby insure smooth and uniform surfaces upon the same, substantially as set forth."

28. For an *Improvement in Railroad Car Seats;* Samuel Hickock, Buffalo, New York.

"My invention consists in the manner or method of constructing these seats, so that they can be easily changed in either direction, and converted from a position to sit upright to that of a reclining seat, and vice versa, so as to serve well the purpose of either a day or night seat, without increasing the space which they occupy over those of ordinary construction, whereby great convenience and comfort is attained for weary travelers."

*Claim.*—"What I claim is, constructing a railroad car seat, by connecting and arranging the sliding seat with the revertible back, hinged at the extremity of the reversing arms, and combining therewith the double ratchet bars, in such a manner that it can be easily converted in either direction into a day or night seat, and at the same time not occupy more space than the ordinary stationary seat, substantially as set forth. I also claim the triangular foot rest in combination with the sliding seat, whereby it is made adaptable to the seat when used either as a day or night seat, substantially as set forth."

29. For an *Improvement in Winnowers;* Lewis S. Ingraham, Cuyahoga Falls, Ohio.

"The nature of my invention consists in making the screen or screens stair shaped or fluted, and vibrating them perpendicularly or diagonally, instead of traversing or shaking them horizontally as heretofore, so that the grain falls successively from one stair or flute to the next, until it passes over all the stairs or flutes in the screen; also, in using it in combination with a plain screen, which may be used either before or after the stair screen, as may be preferred."

*Claim.*—"What I claim is, the stair or fluted screen, constructed and operated substantially as described for the purposes set forth."

30. For an *Improvement in Iron Posts for Fences;* John W. Jenkins, Greenport, New York.

*Claim.*—"What I claim is, the arrow headed or barbed bottom of the post in combination with the twisted cross piece, substantially in the manner and for the purpose set forth."

31. For an *Improvement in Fire Arms;* George Leonard, Shrewsbury, Massachusetts.

*Claim.*—"What I claim is, a revolving fire guide, which by the continued operation of the fire arm, shall successively communicate fire to the different charges of several barrels."

32. For an *Improvement in Printing Presses;* John Lewis, Buffalo, New York.

"The nature of my invention consists of a swinging bail or pressure bail, in combination with the lever power, in such a manner as to bring the power upon the centre of the platen by one motion of the lever."

*Claim.*—"What I claim is, the swinging bail and the pressure bail, constructed and operated substantially as set forth."

33. For an *Improvement in Corn Shellers;* Eben L. Millis, Rochester Depot, Ohio.

*Claim.*—"What I claim is, reducing the larger ears of corn to be shelled, to a nearly uniform size with the smaller ones, by passing the whole through between a toothed cylinder and concave, where the large ears are caught and partially reduced or operated upon, preparatory to their passing with the smaller ones through between a second cylinder and concave, where the entire operation of shelling and separating takes place, the whole being performed substantially in the manner herein described."

34. For an *Improvement in Printing Presses;* Joel G. Northrup, Syracuse, New York.

"The nature of my invention consists in combining with a vibrating bed, a series of intermittingly rotating platens, so that the sheets may be placed on the platen in the most convenient manner, and fall from the platen after receiving the impression, without the necessity of requiring a delivery apparatus, and by which construction I produce a very cheap and very effective press."

*Claim.*—"What I claim is, the combination of the series of intermittingly rotating platens with a vibrating bed, when so arranged as that the delivery of the printed sheet is from the lower of the series of platens, so that it may drop from the platen on to the paper table, or into a drawer, substantially as described."

35. For an *Improvement in Friction Rollers;* James Patterson, Franklinville, N. York.

"The nature of my invention consists in arranging, within a central aperture of the car wheel, and around its axle, a series of anti-friction rollers, each of which has bearing portions of different diameters, the larger of which roll upon the inner periphery of the car wheel, and the smaller upon an enlarged portion of the axle; their proportions may be such that the inner circumference of the wheel shall bear the same ratio to that of the larger portions of each roller as the circumference of the enlarged portion of the axle bears to that of the smaller portion of each of the rollers."

*Claim.*—"What I claim is, fitting the bearing of a rolling car wheel on a fixed axle, with a series of friction rollers, having bearings of large diameter to run in contact with the axle, the latter being enlarged at the point of contact with the rollers, as specified."

36. For an *Improvement in Rolling Railroad and other Iron;* Alfred B. Seymour, Hudson, New York.

"My invention is intended for rolling railroad and other bars which require repeated rollings to complete them, with the view to save labor in handling the bars, and to expedite the rolling, and to avoid or reduce the number of reheatings."

*Claim.*—"I do not wish to limit myself to the modes of application herein specified, as other modes of applying the principle of my invention, either superior or inferior, may be devised. Nor do I wish to limit myself to any particular manner of communicating the driving power to the series of rollers, as any equivalent mode may be substituted, or some better mode may be devised. I do not claim as my invention the employment of a series of draw rollers to act in succession on a bar of iron or other metal, to draw it into a required form, as this has long since been devised and tried; but what I claim is, the employment of a series of pairs of rollers, so arranged that the pairs in the series shall be free to move from or towards each other, to adapt themselves to the condition of the metal in the process of rolling, substantially as and for the purpose specified."

37. For an *Improvement in Repeating Fire Arms;* Joshua Stevens, Assignor to the Massachusetts Arms Company, Chicopee, Massachusetts.

*Claim.*—"What I claim is, to so construct and combine together, substantially as described, the lock, trigger, and mechanism for rotating, and locking and unlocking the chambered cylinder, as that while by a simple pull of the trigger, the operations of unlocking and rotating the magazine or chambered cylinder, relocking it, and discharging the cock, shall be caused to take place by power applied to the trigger alone, the elevation of the cock, or the cocking of it, shall be previously effected by the hand of a person, or means entirely separate from the trigger, as described. And I also claim the combination of the stirrup, the spring bolt, and the lever, arranged and made to operate together, substantially as specified. I also claim the combination of the sectoral plate, (made as described,) with the spring bolt and its slot, the said plate being applied and made to operate essentially as explained. I also claim the method above set forth, of constructing the lever, viz: of two parts, (turning on one common pin,) in combination with their confining and adjusting screws; the whole being substantially in manner and for the purpose above described."

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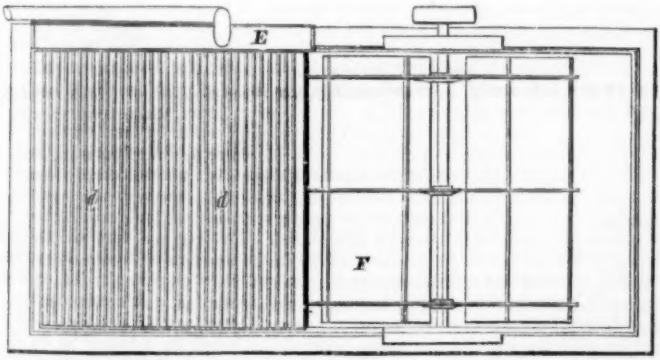
Specification of a Patent granted to B. H. Bartol, of Philadelphia, Pennsylvania, for an *Improvement in Refrigerators for Cooling Water used in the Condensation of Vapor from the Vacuum Pans in the Manufacture of Sugar—and for the Condensation of Steam in Steam Engines;* dated June 28, 1853.

"The nature of my improvement consists in an improved apparatus for cooling water used for the condensation of vapor from vacuum pans in the manufacture of sugar, or for the condensation of steam in steam engines. The improvement is particularly applicable in those sections of country where water is scarce, as by means of this improvement the same water may be employed for condensation, then cooled, and again employed any number of times in succession.

"A is a room 12 feet square, and not less than 10 feet high; this room is filled with a series of vertical board partitions, *b b*, the boards being rough, or corrugated with horizontal seams. Between the partitions there are passages, c c, of about 2 inches wide; at the top of the room, about two inches above the partitions, and in line with them, are a range of horizontal pipes, *d d*. These pipes open into a tank, E, containing the water to

Fig. 1.

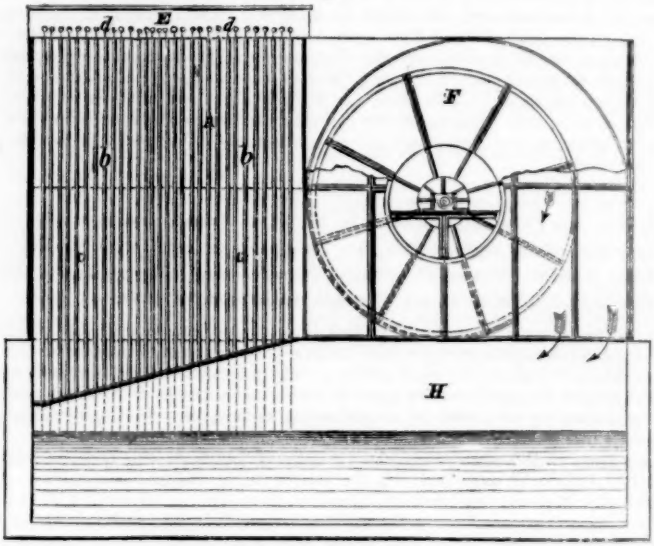



Plan View.

be cooled. These pipes have a row of fine holes along their lower side for the escape of the water. The water then passes directly on to and slowly trickles down the board partitions. The upper edges of these partitions are sharp, so as to divide the water and cause it to pass equally over both sides of the partition. F is an ordinary centrifugal or rotary fan blower, discharging its air into the upper part of the cistern, H. This cistern, H, is entirely closed, except at the interstices between the board partitions, *c c c*.

"The operation of my improved refrigerator is as follows:—The water to be cooled is pumped by any ordinary means into the tank, E. From this tank it flows through the pipes, *d d*, and escapes through the series of holes in their lower side, trickles slowly in very thin streams down the rough or corrugated surface of the boards, *b b*, and finally discharges from the lower end of the boards into the cistern, H. The air discharged by the fan blower, F, is forced to pass from the cistern up through the interstices, *c c*, as

Fig. 2.




Longitudinal Vertical Section.

shown by the arrows, and then escapes between the pipes, *d d*, above. This air is divided into currents by the partitions, and is forced to pass in close proximity to the attenuated streams of water trickling down along the surface of the boards. Hence a rapid evaporation and consequent cooling of the water results. A single passage of the water down the partitions cools it sufficiently. The boards, *b b*, instead of being arranged vertically, as indicated in the drawing, may be placed in an inclined position, the interstices being preserved.

"Heretofore, fan blowers have been applied to cooling water by causing the water to be dropped from an elevated tower through an ascending current of air from a blower; but that mode is objectionable, inasmuch as the size of the drops are not sufficiently attenuated to be thoroughly cooled. Second, the contact of the air with the water is not sufficiently intimate, much air passing out without producing evaporation; and, thirdly, the construction of towers of considerable elevation is required. The last is a very serious objection, on account of the trouble and expense involved in the erection of towers on sugar plantations, and in situations in which refrigerators are generally employed. These towers are required to be about 40 feet high; whereas, by my apparatus, a structure 10 feet high is amply sufficient. Moreover, it will be readily seen that at least 75 per cent. of the power required to raise the water to the upper reservoir, is saved on account of its decreased elevation. By my improvement, therefore, the expensive construction of tower is dispensed with, and a much more complete and economical cooling of the water is effected.

"I do not desire to claim the application of the current of air of a fan blower to cool water; but what I desire to claim and secure by Letters Patent is, the arrangement of the series of partitions and interstices for cooling water, in the manner and for the purpose substantially as herein set forth."

# MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

## *Remarks on Captain Ericsson's Caloric Engine.*

Several of the recent numbers of *Appleton's Magazine* have contained articles for and against the caloric engine of Capt. Ericsson. Maj. Barnard, of the U. S. Engineers, having demonstrated, theoretically, that the whole thing is based upon erroneous suppositions, which cannot possibly be true, Capt. Ericsson replies, and demonstrates in *his way*, that the engines in the ship *Ericsson* possess a power of more than 1200 horses, subject to such deductions for friction, &c., as practice may determine to be correct. Without examining into the correctness of the data used by either of the above gentlemen, it must strike an ordinary observer that while the arguments of Capt. Ericsson are plausible, those of Maj. Barnard are more in accordance with the facts. Capt. E. attributes the failure to the weakness of her cylinder bottoms, which are the tops or crowns of her furnaces; he is correct if he means by this to say that during the trip to Washington, the cylinder bottoms became so far injured as to be useless for further operations, and I have reason to suppose that they were fractured on the second trial trip; but on the first he makes no complaints; every thing is all right, and the vessel comes up to the expectation of himself and friends. The days of steam are numbered, and the newspapers of the next day proclaim to the world the entire success of the ship; and yet, at this time, the useful effect of the engines was but about 250 horses power, being only 20 per cent. of the amount Capt. E. claims, subject to the deductions before stated. Now, I am quite certain that at no time did the engines of the *Ericsson* come up to the expectations of Capt. E., for one of the first things done after the first trial, at the dock at Williamsburg, was to reduce her wheels, (which were not beyond the ordinary size); thus, at the very outset, virtually admitting a deficiency of power where he expected an abundance. Capt. E. has now abandoned his former engines, and is putting in those which have much smaller parts, intending to use compressed air, (and skeptics do say that he intends to use a steam engine to compress the air and make up for the waste)

Maj. Barnard has been writing to prove that the engines were deficient in power, because based on wrong principles. Capt. E. defends the principle, but admits their failure by taking them out of the ship, although as yet, he does not confess the fact to the public. It must be remembered that Capt. E. has never put one of his engines successfully at work; his model engine, reputed at 60 horse power, has remained almost entirely inactive for the past eighteen months. By using it in the works of Messrs. Hogg & Delamater, (who manufacture all his machinery,) he would have confused his enemies and comforted his friends. Hogg & Delamater, although active friends of Capt. E., still persist in using an ordinary high pressure engine to drive the machinery at their works, while they are almost exclusively occupied in the construction of caloric engines; but unfortunately, as yet, none of them have ever been finished,

(except the one for the *Evening Post*, which was sent to France.) Capt. E. may now write volumes in regard to the theory of his engine, and not produce the least impression; but if he wishes to convince, he has only to put one of his engines *at work*, and invite those competent to judge, to examine it and report, and he will do more in one week (if successful) to establish his fame, than by years of mysterious movements, however well supported by kind friends, who, at a later period, must condemn the same policy they now approve. True science should never seek the dark, but soar on eagle's wings.

WATT.

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*Separation of Gold from Arsenical Pyrites, according to Plattner's Method.* By W. GUETTLER.*

The mines of Reichenstein, in Silesia, abandoned for more than five centuries, have been recently opened with advantage, in consequence of the application, on a large scale, of a method invented by Professer Plattner, for separating gold from the waste of arsenical ores.

The ore at Reichenstein is an arsenical pyrites, containing about 200 grains of gold in the ton. The ore is roasted in a reverberatory furnace surmounted by a large condensing chamber, in which the arsenious acid is condensed as fast as it is volatilized. There then remains on the floor of the furnace, oxide of iron mixed with a certain quantity of arsenic, together with the whole of the gold. This is placed in a vessel so arranged that a current of chlorine can be passed through it, by which the gold and iron are taken up, and afterwards separated from the residuum, by the aid of a certain quantity of water, and the gold is afterwards precipitated from this solution by sulphuretted hydrogen. To prevent the admixture of iron at this stage, a small dose of hydrochloric acid is added to the solution before the sulphuretted hydrogen is introduced. The auriferous compound having been separated from the liquor, is washed and heated in an open porcelain crucible, to drive off the sulphur, by which the gold is reduced to the metallic state by fluxing it in the usual manner.

This simple and ingenious method, which has made it worth while to re-open the Reichenstein mine, is equally applicable to the vast quantity of refuse accumulated near many other old works. In awarding the Council Medal, the Jury have desired in this case to associate the name of Professor Plattner, the inventor of the method, with that of M. Guettler, who has brought it into operation on a large scale.

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Translated for the Journal of the Franklin Institute.

*Method of Raising Heavy Weights under Water.*

From a recent number of *Cosmos*, an admirable weekly scientific periodical, edited in Paris by the Abbé Moigno, best known perhaps, in this country, by his excellent work on electric telegraphs, we extract the following account of a recent experiment:—"On Saturday last, Doctor

*From the Reports of the Juries of the Exhibition of the Works of Industry of all Nations, 1851. London.

Gianetti, inspecting physician of the waters of Verdese, (Corsica,) invited us to be present at an experiment, at the same time very curious and very important, on the margin of the Seine, near the bridge *des Arts*. The object was, by means of a small balloon of about a foot and a half in diameter suddenly inflated at the bottom of the water, to lift to the surface a weight of one hundred kilogrammes, (225 lbs.) The *modus operandi* of the Doctor is very rational and very simple; he caused to be constructed in very stout metal, a vessel with two compartments and three tubulures; by two of these tubulures he pours into one compartment, bicarbonate of soda, into the other, hydrochloric acid; on the third tubulure he screws the balloon of leather, or some very strong impermeable stuff. In the experiment at which we were present, the vessel with the balloon was fixed to the ring which united the four weights of 25 killogrammes, (56 lbs.,) before the weights were lowered into the water, and workmen lowered the whole to the bottom of the river. A thin cord which Mr. Gianetti held in his hand, had been fixed to a small arm of a lever upon the vessel; by pulling it he opened a stop-cock, and established a communication between the two compartments of the vessel, so as to mix the two liquids; the acid and salt reacting upon each other produce a very abundant disengagement of carbonic acid; immediately the balloon became inflated, developing a considerable ascensional force, and we saw it rise to the surface, bringing with it the four weights.

Remarks.—We cannot say that there is anything of value in this, beyond the well known and long applied principle in use in our floating docks and camels, where caissons filled with water are first sunk and placed around the mass to be raised, and then the water being replaced by air, by means of pumps, the whole body rises in the water; but it is possible that M. Gianetti's method of replacing the water by gas may be available in some cases where the other, less expensive and more effectual method could not be applied. Ed.

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Translated for the Journal of the Franklin Institute.

## *Experiments on the Undulatory Theory of Light.*

In a former number of our *Journal*, we have brought to the notice of our readers the extremely ingenious and delicate experiment by which M. Foucault, of Paris, confirmed the undulatory theory of light, and demonstrated the falsity of the emission hypothesis. The following article, which we translate from the pages of the Abbé Moigno's *Cosmos*, furnishes another no less extraordinary confirmation of the same theory by the application of extreme mechanical nicety:

"M. Nobert, a German optician, has succeeded in tracing upon a surface of polished glass, perfectly parallel lines, the distance of which apart is only the five-thousandth of a millimetre, (0·000008 inch,) the length of a wave of light, and has desired to make his marvellous skill subserve the triumph of the undulation theory. For this purpose he has executed three plates, which we did not wish to describe until we had seen them

ourselves. They were sent to us by M. Albert, of Francfort, only a few days ago. We immediately appealed to the zeal and optical resources of M. Jules Duboscq, to the skill of M. Nachet, and perfection of his microscopes; with the German instructions in our hand, we repeated the fundamental experiments; they fully satisfied us; we were convinced that the plates of M. Nobert were the true touchstone of the optical theories, and we recommend them to all physicists as a charming and good thing.

*First Plate.*—In the centre of a quadrangular strip of glass are traced seven groups of equi-distant parallel lines; the lines of each group are equally spaced; the different groups are separated from each other by a greater interval; in passing from one group to another, the distance of the lines apart augments, and the seven distances are proportional to the wave-lengths of the seven principal colors of the spectrum; *violet*, *indigo*, *blue*, *green*, *yellow*, *orange*, *red*; the following are the distances expressed in millionths of a Parisian line: 1st group, *violet*, 900; 2d, *indigo*, 1000; 3d, *light blue*, 1075; 4th, *green*, 1188; 5th, *yellow*, 1325; 6th, *orange*, 1450; 7th, *deep red*, 1600.

When these seven groups have been traced upon the plate, it is covered with a very thin protecting slip with parallel faces, and there is engraved upon this slip with the point of a diamond, a star, a double arrow, and a double candle with its flame, as is shown in the accompanying figure.

Fig. 1.

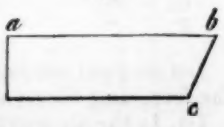
To observe, we take a microscope magnifying from 16 to 27 times; if the lenses have not, like those of the French microscopes, a very small diameter, a small disk of blackened metal pierced with a small hole, is placed in the mounting of the objective; the plate is placed on the table of the microscope, with the arrow pointed towards the light (the best of all lights is that from a white cloud); between the mirror and the light is erected, five or six inches from the mirror, a screen pierced with a horizontal slit six inches long and one-third of an inch wide, which throws the light upon the side of the mirror corresponding to the flame engraved upon the plate; while looking through the eye-piece, the mirror is gently turned, and soon seven colored bands or seven flat or uniform tints appear in the field of vision, representing the seven principal colors of the solar spectrum, separated by dark very distinct and very brilliant intervals. The plate may be placed in two different ways on the table of the microscope; with the protecting plate either above or below. In the first position, the interferences which produce the colors, evidently take place in the sheet of air between the plate and its cover, and the spectrum produced may then be called the air spectrum; in the second position, the interferences take place in the glass, and the spectrum is the glass spectrum. Now, observation shows that these two spectra are completely identical, that the colors are exactly the same, as they ought to be according to the theory of undulations, which thus receives a simple and striking confirmation. Let us enter upon a short explanation on this subject: if everything has been arranged as we have said, the luminous ray falling upon the groups of lines will make, (and this is the normal condition of M. Nobert's experiment,) with the perpendicular to the plate,

an angle of 11° 24′. Then, if we call $d$ the distance of two of the equidistant lines in any one of the groups, $\lambda$ the wave-length corresponding to the color which this group gives, we ought to have $\lambda = d.\ sin.\ 11° 24'$. And in fact, if we consider for example, the indigo group for which $d = 0{\cdot}0001$, we have $0{\cdot}0001 \times sin.\ 11° 24' = 0{\cdot}000197$, and 197-millionths of a line is, in truth, the wave-length of the indigo ray. Besides, every observer, by unscrewing his objective lens magnifying from 15 to 20 times, and replacing it by a system of lenses magnifying from 180 to 200 times, will see the parallel lines of each group clearly separated; he may measure their relative distance, $d$, calculate the seven products, $d$, $sin.\ 11° 24'$, which will give him the seven known wave-lengths of the seven principal colors of the solar spectrum.

But, if the covering plate be below, the angle of incidence, $i$, becomes the angle of refraction $r$, determined by the equation $sin.\ i = n.\ sin.\ r$, $n$ being the index of refraction for glass; it is thus an angle which has for its sine $\frac{sin.\ i}{n}$. If, then, we call $\lambda'$ the wave-length, in glass of the color given by the observed group, we shall have $d = \frac{\lambda'}{sin.\ r} = \frac{\lambda' n}{sin.\ i.}$ Observation proves that the color after turning the plate, remains the same; we shall then have $\lambda = \lambda' n$, or $\lambda' = \frac{\lambda}{n}$; consequently, the wave lengths in glass are shortened, as the undulatory theory requires in the ratio of $\frac{1}{n}$, of unity to the index of refraction. It is, besides, a first principle in this theory, that, 1st, the time $t'$ of the luminous vibrations cannot change from one medium to another; 2d, that the velocity of propagation in a given medium is measured by the ratio of the wave-length $\lambda$, to the time $t$, of the oscillations; if, then, we call $v$ and $v'$ the velocity of light in air and in glass, we shall have $v = \frac{\lambda}{t}$, $v' = \frac{\lambda'}{t}$ and, consequently, $\frac{v}{v'} = \frac{\lambda}{\lambda'} = n$. Thus, the same very simple experiment, made with Nobert's plate, which proves that in glass the wave-lengths are less than in air, in the ratio of $\frac{1}{n}$, proves also that the velocity of light in glass is smaller than that in air, in the ratio of unity to the index of refraction. In the double point of view of elegance and simplicity, the experiment of M. Nobert is altogether comparable with that of M. Arago, who showed the retardation of velocity in the most refracting medium, by the displacement of the interference fringes, and in these regards, much surpass those of M. Foucault.

*Second Plate.*—On the face $a\ b$ of a plate of glass two lines thick, twenty lines long, and ten lines broad, of which the second face, $b\ c$, highly polished, makes, with the face, $a\ b$, an angle of about 75°, are traced parallel to the length, and very near the acute angle $a\ b\ c$, a series of fifteen groups of parallel lines, designated by the letters of the alphabet from A to P, and such that the distances $d_a$, $d_b$, $d_c$, &c., are

Fig. 2.



exactly represented in millionths of a Paris line by the following numbers:

A, $d_a = 400$; B, $d_b = 350$; C, $d_c = 300$; D, $d_d = 275$; E, $d_e = 250$; F, $d_f = 237$; G, $d_g = 225$; H, $d_h = 212$; I, $d_i = 200$; K, $d_k = 188$; L, $d_l = 175$; M, $d_m = 163$; N, $d_n = 150$; O, $d_o = 138$; P, $d_p = 125$.

The divisions are also covered by a protecting slip of glass, on which are engraved, as indicated in the subjoined figure, a slit, an arrow, and a candle.

Fig. 3.

To observe with this plate, a microscope magnifying from 40 to 50 times, must be employed; it is absolutely necessary to close all access for the light coming from below, and for this purpose, the mirror is covered with a thick coating of black stuff, velvet for instance; the lens is diaphragmed, as in the foregoing experiment; the plate is placed upon the horizontal table of the microscope, at first with its cover above, turning the polished face, *b c*, towards the light. The light, that of a white cloud for instance, is made to fall upon the divisions under an angle of about 20° 20′ with the plane of the lines; we look through the eye-piece, and when the vertical plane of illumination is perpendicular to the lines of the divisions, we see fifteen colored bands appear, the tints and wave-lengths of which, calculated by means of the formula $\lambda = d$, cos. 20° 20′, are given in the first column of the following table, always expressed in millionths of a line.

So far the interferences which give rise to the colors, are produced in the stratum of air included between the ruled plate and its cover; but if we invert the plate, placing the cover below, leaving always the polished angular face turned towards the source of the light, we will see fifteen new colored bands, the tints and wave-lengths of which, calculated by means of the formula, $\lambda' = d$, cos. 20° 20′ (supposing that the illuminating ray has kept the same direction,) are given in the second column of the table.

| *Interferences in the Air.* | | *Interferences in the Glass.* | |
|---|---|---|---|
| A, violet, | | A, red, | |
| B, deep red, | $\lambda = 328$ | B, burnt yellow, (*jaune brulé*), | |
| C, light orange, | $= 281$ | C, green, | |
| D, sulphur yellow, | $= 258$ | D, indigo, | |
| E, beautiful green, | $= 234$ | E, violet, | |
| F, greenish blue, | $= 223$ | F, violet red, | |
| G, blue, | $= 211$ | G, gray, | |
| H, indigo, | $= 199$ | H, red, | $\lambda' = 199$ |
| I, violet | $= 187$ | I, red, | $= 188$ |
| K, very deep violet, | $= 175$ | K, orange, | $= 177$ |
| L, dark grey, | | L, burnt yellow, | $= 165$ |
| M, " | | M, yellowish green, | $= 153$ |
| N, " | | N, green, | $= 141$ |
| O, " | | O, indigo, | $= 130$ |
| P, " | | P, violet red, | $= 118$ |

Let us point out rapidly the consequences which may be drawn from the foregoing observations:

1st, In the air spectrum, the five groups, L, M, N, O, P, when we are

very careful to remove every extraneous light give no color, and this is again a striking confirmation of the undulating theory, according to which the interference colors disappear so soon as the product *d. cos* 20° 20′ is less than the wave-length of the luminous rays in the air.

2d, In the first position of the plate, the groups B, D, I, give respectively, red, yellow, and violet; in the second position it is the groups H, L, P, which give nearly the same red, the same yellow, and the same violet, &c. If the undulating theory is true, the intervals of these last three groups must be smaller than those of the former in the ratio of unity to the index of refraction of glass; and, in fact, if we calculate the three ratios $\frac{d_b}{d_h}$, $\frac{d_d}{d_l}$ and $\frac{d_i}{d_h}$, we shall obtain numbers sensibly equal to 1·525 the coefficient of refraction of the glass of the plate.

3d, The wave-length corresponding to the color of the group B, seen in the air, proves that there exist towards the red extremity of the spectrum colored rays having a wave-length greater than those which have hitherto been measured; and this fact should surprise us the less, since M. Brewster and Mathiessen have proved that the extreme red extends far beyond the limit which was assigned to it. Fraunhofer, moreover, measured the wave-lengths only for the waves included between the fixed lines B and H. According to M. Herschel, the wave-length of the extreme red is 0·000312, and M. Nobert's has for its wave-length, 0·000328; according to M. Herschel, moreover, the wave-length of the extreme violet is 0·0002, and M. Nobert's plate descends to 0·000175.

4th, Several of the colors given by the plate are the octaves of each other, or are, one of the first, the other of the second order; the red of A and that of I, the yellows of B and of L, the greens of C and of N, the indigoes of D and of O, are in this condition, their wave-lengths are in the ratio of one to two.

To give an idea of the difficulties which M. Nobert has had to overcome, to succeed in tracing these groups with certainty, we will remark that it is necessary not only that the lines of each group shall be perfectly equi-distant, but that from one group to another these distances should vary by quantities which are really infinitely small. Thus the difference $d_n - d_o$ between the distances of two contiguous lines in the groups N and O, is only $\frac{1}{1\cdot000\,000\,000}$ths of a line, or a little more than $\frac{1}{1\,000\,000}$ths line, and this distance is sufficient to cause the color to pass visibly from green to indigo; the lines of M. Nobert are therefore accurate to nearly one-millionth of a line. The tenth group already escapes from the power of almost all microscopes known; that is, their highest magnifying powers do not permit us to separate clearly, and to count the lines of group O, and the groups below it. M. Nobert himself has constructed microscopes which separate not only the lines of these five groups, but lines still more close, the distance of which is only $\frac{1}{3\,000}$ of a line, and permit us to perceive the real, but confused separation of lines distant from each other $\frac{1}{5\,000}$ of a line.

*Third Plate, Colored line Micrometer.*—Upon a thin plate of English glass, highly reflecting, very transparent, but slightly absorbent, have been engraved five groups of equi-distant parallel lines. The distance

between two contiguous lines of each group is $\frac{3}{1}\frac{2}{0}\frac{5}{0}\frac{5}{0}$ths of a line; the breadth of each group is $\frac{1}{3\,0}$th of a line; that is, the thickness of one of the threads used in an ordinary micrometer; the intervals between the groups are such that a star situated in the equator, and looked at through the micrometer placed in a telescope, will require fifteen seconds to pass from one group to another. The micrometric plate, placed as we have described, is illuminated obliquely by the ray of a lamp or gas burner, penetrating through an opening in the eye-piece tube, at a small distance from it. The lamp or illuminating object is placed upon a movable arm, carrying besides, a vertical screen with a longitudinal slit, and turning around its axis provided with a graduated circle, so that the luminous rays may fall on the micrometrical plate under any inclination from 0° to 90°, and so that at any moment the angle of incidence or the angle of the ray with the plane of the groups can be read off upon the circle. This being supposed, if the ray makes, with the plane of the groups, an angle of 15°, or with the perpendicular to the micrometric plate, that is, with the axis of the telescope, an angle of 75°, the five groups will give rise to five lines of red light, which will be replaced by five lines of another color if the movable arm is turned; these colors may consequently pass by degrees through all the tints of the solar spectrum; so that a color being given, we may always find a position of the movable arm, which colors the groups with the same tint.

As long as the incidence of the ray, or the position of the movable arm remains fixed, the micrometric plate behaves like the ordinary micrometer with illuminated lines; it also replaces the glass plate which in M. Lamont's method receives the images of the illuminated lines outside of the eye tube. As the colored bands can be seen as well through the object glass as through the eye-piece, the new micronometer may be used with great ease and certainty, either for the determination of the nadir according to the method of Bessel, or for fixing the position of the zenith according to the process of M. Faye. But the application which pleases M. Nobert the most is, the use which may be made of his plate for determining in a precise manner, the constant or variable colors of the stars. In truth, from the very fact that by turning the movable arm, or varying the angle of incidence of the ray, we may always color the bands with the tint of the star seen in the interval between the groups, the personal errors of the observer will be completely eliminated, and moreover, the color of the star may be immediately expressed in numbers. In fact, if we call $\lambda$ the wave-length, $d$ the distance of two contiguous lines, $i$ the angle of incidence of the ray, we shall have $\lambda = d, \cos i$.

The plate will not only be a *chromatometer*, it may also serve as a photometer; for, by varying the length of the arm without changing its direction, that is, by increasing or diminishing the distance of the illuminating body from the plate, we augment or diminish the brilliancy of the bands; they may thus always be brought to have the same degree of brightness as the images of the stars whose relative intensity of light may be thus determined. To make these latter observations easier, M. Nobert purposes to replace the plate with seven groups by a plate with but a single group, but much larger, formed, for instance, of 80 or 100 parallel equi-distant lines, to observe the stars, not in focus, but without it, as in the photometer of Steinheil, so as to give their images a certain diameter; then, after having produced

the similarity of tint, to bring them to equal intensity by opening or closing the parallel slit through which the rays pass. Since, as we have said, the wave-length of the light of the star can be calculated, we shall have not only its relative brilliancy, but also its specific brightness deduced from the breadth of the oscillations.

M. Nobert has undertaken to make actual observations in this new direction; we shall report them as soon as they are published.

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### *Launch of the Steamship Himalaya.**

On Tuesday last, the launch of the largest ship in the world—the huge *Himalaya*, built by Messrs. Mare and Son, for the Peninsular and Oriental Steam-Packet Company, took place. Her length aloft is 340 feet, and at the keel 311 feet; depth of hold, 34 ft. 9 in., and burthen 3550 tons, being considerably more than the *Great Britain*, once the great nautical wonder of the world. The engines are equal to 700 horses power, and are expected to drive her at a rate of from 12 to 14 miles per hour. The *Himalaya* was intended originally for paddles, but subsequently was adapted to the screw. The engines are in course of construction at Messrs. Penn's. The *Himalaya* is to have an entire outfit of Trotman's patent anchors; the two bower anchors will be 48 to 50 cwt. in weight, whereas anchors of the old description would have reached five or six tons. She will have accommodation for 400 cabin passengers, 500 tons of measurement goods, and 1200 tons of coal.

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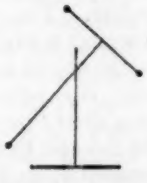
### *On the Mechanical Imitation of Precession.* By the Rev. Prof. Powell, F. R. S., &c.†

The actual mechanical exhibition of the composition of rotary motion giving the physical explanation of the Precession of the Equinoxes has been attempted by more than one contrivance.

In the *Astronomical Notices*, vol. i. p. 43, appears a description of a machine of this kind by Mr. Atkinson, but so brief that it is difficult to collect what the principle of it was. It is also understood that another instrument was constructed by the Astronomer Royal; but of this it does not appear that any description has been published.

In the present instance, before the author was aware of either of these contrivances, he had constructed one which he believes exhibits the essential mechanical principle with greater simplicity than any previously devised.



It consists merely of a bar (loaded at its ends) capable of rotating freely about one end of an axis, which itself can turn about a point in its length, near the end carrying the bar, upon an horizontal axis capable of moving in azimuth round a vertical pillar. At the lower end of the first axis is a weight, which *rather more* than counterpoises the upper part; and when there is no rotation in the bar, simply brings the first axis down into a vertical position.

* From the Journal of the Society of Arts, London, No. 27.

† From the Proceedings of the Royal Astronomical Society, May 13, 1853.

If this axis be held horizontally for obliquely, and a rotary motion be given to the bar about it, on letting the axis go, the weight will no longer bring it down, nor alter its inclination at all, but will cause the whole to turn in azimuth, in a direction opposite to that of rotation.

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*Application of the Microscope to Photography.* By the Rev. W. Towler Kingsley.*

The author commenced by a brief account of the laws of refraction, the nature of the prismatic spectrum, and the separation of a ray of light into the heating, light-giving, and chemical rays; he then said—

I shall now proceed to state what is the nature of the change produced by the action of light on silver salts. We may easily conceive that the molecules of the simple substances of which a compound body is formed are capable of different periods of vibration, like two strings of different note; and hence, if the vibrations of the luminiferous ether are taken up by one substance and not by the other, and the chemical affinity of the one for the other is at the same time feeble, chemical decomposition would ensue. This, at any rate, seems to be a reasonable view of the case. The salts of silver are very easily decomposed, and there is always a tendency in them to allow the silver to return to the metallic state. For instance, the oxide of silver is reduced to the metal by heat with great ease, or by placing it in contact with any substance that has a considerable affinity for oxygen. This action, however, is much more rapid if the process be carried on in strong sunshine. The iodide of silver follows the same law; but bromine and chlorine have a greater affinity for silver than iodine; and if we expose iodide of silver to the action of bromine or chlorine, or of both in order, we shall disturb the feeble affinity of the iodine for the silver, and render the compound so unstable that the action of light is quite able to reduce the metal; and if we stop short before we reach this point, it is still possible to carry on the further reduction of the metal by the use of substances which have a slightly greater affinity for the iodine than the silver has in its now altered condition. This process constitutes the whole practice of photography; for though other metals than silver can be used for the purpose, it is the cheapest as yet known that possesses the property of returning to its simple form with sufficient ease for the purpose.

The process of Daguerre, as now practised, is to expose a polished and clean silver plate to the action of the vapor of iodine, and then, for a very short time, to that of bromine, and then a second time to that of iodine. This treatment coats the plate with iodide of silver, and then liberates a portion of the iodine, bromine taking its place. The image of the object to be delineated is now formed upon the plate, and then the plate is exposed in the dark to the action of the fumes of mercury, which in a short time whiten the parts that the light has acted on. It used to be thought that the image was formed by particles of mercury being deposited upon the surface of the silver. This, however, I am sure, is quite a mistake; and though I am unable to explain the whole action that takes

* From the Journal of the Society of Arts, London, No. 25.

place, I have no doubt of the nature of it. The vapor of mercury has a decided affinity for oxygen, iodine, bromine, and chlorine; when, therefore, the plate is exposed to it, the vapor deprives the iodide of silver of its iodine, and deposits pure silver. When bromine and chlorine are also present, silver is reduced, and at the same time salts of mercury are formed; and I have no doubt that the different colors of the lights, according to the different proportions of iodine, bromine, &c., are due to these salts of mercury; but as the quantity is very minute, it is a matter of great difficulty to detect them,—calomel and the black oxide I have detected. After the plate has been acted upon by the mercury, it is fixed by first removing the unreduced iodide by a bath of hypo-sulphite of soda, and then by gilding it slightly with hypo-sulphite of gold. If the action of the light be too strong, metallic silver is formed at once, and then the mercury unites with it, and forms an amalgam that is not as light in color as the silver reduced in the first instance. This seems to be one of the points where there is hope of gaining by further experiments; for if some way of reviving the silver on those parts of the plate where the light has not actually reduced the silver can be discovered, without destroying the revived parts, we should be able to make sure of every plate by merely giving time enough to the exposure to the light. I may mention that the vapor of aldehyde gives promise of effecting this object. As a deoxidizing or deiodizing agent, it is most powerful, but the difficulty is to restrain its action. For the microscope, Daguerreotype plates prepared in the usual manner are quite capable of receiving an impression in about a minute's exposure. These impressions, however beautiful, will never be as useful as those taken on glass or paper, and which admit of being copied photographically.

The most simple process is that known under the name of the Collodion Process, introduced by Mr. Scott Archer.

It is not worth while to describe the method of making collodion, as it can be bought ready made as cheap as it can be made. With it a very small quantity of iodide of silver, dissolved in iodide of potassium or in cyanide of potassium, is mixed. This is now to be poured on a plate of glass, and the excess poured off again, so as to leave a film of the preparation on the glass surface. The plate is now to be plunged into a bath of nitrate of silver, 30 grains to the ounce of water; and as soon as the whole of the plate will retain the water without running into streaks, the plate is to be exposed to the action of the light; then it is to be plunged into a bath of pyrogallic acid, 3 grs.; water, 1 oz.; glacial acetic acid, 1 drachm. This deiodizing and deoxidizing bath develops the image; the unreduced iodide is then to be removed by hypo-sulphite of soda. This is the ordinary process, and the method is simple and good. If we add to the collodion mixture a small quantity of iodide or bromide of iron, and develope with protonitrate of iron, the process is rendered much more energetic; for we obtain on the plate, as soon as it goes into the silver bath, nitrate of iron, which deiodizes the plate as soon as the light strikes it. I do not find these preparations of iron to keep well, and therefore the preparation should be made only a short time before it is to be used. Iodide and bromide of arsenic are also admirable accelerators, and appear to keep for months without change; with them either the pyrogallic solution

or protonitrate of iron may be used. I do not think that the collodion process will be as good as the paper processes, because it is a very difficult matter to coat large glass plates; and after they are finished, they take up a great deal of space; also, they are more troublesome to take positives from.

I may here mention that albumen, treated exactly the same as the collodion, only dried and heated after being poured on the glass, acts just as well and as quickly.

I shall now describe the method of preparing the paper I use. I have no doubt that many others are just as good.

I prefer Canson's paper, and use it either waxed or not, with nearly the same results; but the waxed paper is the more easily managed, on account of its not becoming so tender from soaking. The paper is first to be soaked for some hours in a bath as composed below:

Distilled water, 1 pint;
Iodide of potassium, half-an-ounce;
Bromide of potassium half-a-drachm;
Fluoride of potassium, 1 drachm;
The whites of two eggs.

If this is done under the air-pump, so much the better. The paper is now to be hung up to dry, sheet by sheet; and so prepared, it keeps well, certainly for months. If arsenic be added, as in the collodion, the paper is more sensitive. When it is to be used, it is to be plunged into a bath composed as follows:

Nitrate of silver, 30 grains;
Acetic acid, half-a-drachm;
Distilled water, 1 ounce.

After the paper has become saturated in this bath, it is to be placed on a sheet of pure blotting paper, and that on a sheet of glass, on which it will adhere from the superabundant fluid; it is now to be exposed to the action of the light for the required time, which of course depends upon the intensity of the light; with my microscope, from two to five minutes is quite enough. It is then to be developed in a bath of saturated gallic acid; if the image does not seem dark enough in an hour, a few drops of the silver bath should be added. Hypo-sulphite of soda as usual is the fixing agent. The silver may be used over and over again, if it be filtered with animal charcoal after each time it is used, or as soon as it shows the least sign of becoming discolored.

In these processes we have the affinity for the iodine disturbed by the action of the light; the developing agent carries this further, and the oxygen of the air or water or acid, which has always a slightly greater affinity than iodine for silver, combines with the liberated silver, and produces the dark parts of the impression; if the action is carried still further, we get the silver revived; and in the collodion process this produces a positive. To obtain these collodion positives, the quantity of silver in the collodion should be small, and the exposure only for an instant; after the plate is developed and fixed, it should be put into a bath containing either aldehyde or grape sugar, which will revive the silver with great bril-

liancy. The paper pictures may be developed by placing them in the mercury box, but it is not a good way of doing it. There is one use of the collodion which is of service. In the use of very high powers with very delicate objects, it is not easy to see the image formed on the vesculine screen as described hereafter. When therefore an approximate focal distance has been obtained, a collodion positive on a small scale of a portion of the image can be taken in a few moments, and so the correctness of the arrangements tried before placing the paper in its place.

I shall now proceed to describe the instrument I use. Sunlight is of course far superior to any artificial light, when we can obtain it; but as the sun will not shine whenever we choose, it is of the greatest importance to construct the instrument for artificial light, and then modify it so as to be applicable to sunlight. The light I use is the common oxyhydrogen light; magnesia or quartz may be substituted for lime ball with advantage.

The optical parts of the instrument divide themselves into four groups. The light collecting, the condensing, the objective and magnifying lenses. The first group for collecting the light consists of three lenses; the first a meniscus of about three inches focal length and two and a half diameter, the second plano-convex, and the third a double convex with the radii of the surfaces one and six. The focal lengths of these two lenses being respectively six and eight inches.

The second group, or condensing lenses, is a similar one turned the other way and on reduced scales to suit the different object glasses; between these two systems there is a plano-convex placed at its focal length from the focus of the collectors, so as to allow the rays to pass parallel to the condenser. This lens and the condensers must be changed with the object glasses; for it must be borne in mind that we have to arrange the instrument so as to make the image of the lime ball just cover the paper to be acted upon; and so if we diminish the focal lengths of the condensers at the same time that we increase the magnifying power of the instrument, we shall have just as great an amount of light with the highest as with the lowest powers.

The next group of lenses are those of the object-glass, which requires to be very much under corrected for visible color, leaving strong red fringes. A very simple way of making the object-glasses of an ordinary good microscope do for photographic purposes is to have a new front lens made for them; so that they can be used for either the ordinary or the photographic microscope. At this point of the arrangement we have a very good form of the oxy-hydrogen microscope; but it is a bad one for photography, as we cannot have the screen on which the image is to be formed, so near, as to enable us to use the slow motions of the various arrangements at the time we are looking at the image, except for very low powers.

We now come to the last group, which occupies the place of the eye-piece of the ordinary compound microscope. This group is a form of the Ramsden or positive eye-piece, which ordinarily consists of two plano-convex lenses, placed at two-thirds their focal length, which is the same in both, and with their plane sides out. This eye-piece is not achromatic, being under corrected. The addition of a plano-concave flint lens to a double convex crown, is used by me in the place of the lens next the

object. This enables me, by a slight change of distance, to make the correction perfect.

I have only to describe the best way of using this instrument; and here, it must be remembered, that all depends upon the object-glass being good; it is very easy to get one of small angle that will give very short outlines of objects, but we must not be content with such images as these; we must get object-glasses of large angular aperture, made perfect for this purpose, so as to show well the structure of objects, as well as their outlines. This is quite feasible. Suppose, then, that we have got a perfect instrument.

At the place of the focus of the object-glass place a screen of æsculine, and a dark blue glass between the collectors and condensers; we shall now, "thanks to Professor Stokes," see the chemical image; and the correction for spherical aberration must now be made in the ordinary manner. Now put in the eye-glass or magnifier, and the æsculine at the screen, and adjust the focus. This focus will be found even in the case of chemically corrected lenses, beyond the visible; but in the case of the ordinary best object-glasses, the difference is enormous; for instance, in the case of a very fine one-fifth in my possession, if I form an image at one foot from the eye-glass, I find the chemical image ten feet further back; of course, such a lens is of *no* use for photography.

The æsculine also enables one to see at once when the light on the screen is the most intense for chemical action.

In conclusion, I have to state that one of the specimens sent was taken upon a disk of five feet diameter, which was illuminated equally, and therefore anything may be taken on that scale on paper with artificial light, and I dare say on a very much larger scale still. I look upon it, therefore, that we must give our chief attention to the corrections of the lenses, as all the other parts of the process seem to require little further than mere care in the use of common formula. I have also to add, that the focal length of the condenser being selected, in order to give the image of the incandescent spot of lime on the right scale, its angular aperture should be a shade less than that of the object glass.

Also, if a spot of tin-foil be placed on the condenser, we can get the object bright on a dark ground; and if an opaque object be placed in the focus of the collecting lenses, and the object-glass and eye-piece be turned round to the front of the object, a very good image may be got with low power.

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Mr. Foster, as an amateur in photography, wished to express his high sense of importance of Mr. Kingsley's experiments, especially with regard to lenses, in respect to which they were far from having arrived at perfection. The data, however, furnished by Mr. Kingsley's experiments would, he trusted, lead to results more satisfactory than had hitherto been gained.

A Gentleman, referring to some of the experiments Mr. Kingsley had just shown, asked if there were anything peculiar in his mode of bringing out the Daguerrean image?

Mr. Kingsley said he had merely performed the experiment in question for the purpose of showing that the development of the image on a daguerreotype plate did not depend, as some suppose, on the precipitation of mercury on its face. The agent he had used for that purpose was merely a solution of common pyro-gallic acid.

The Chairman said, that as by means of the microscope beauties were discovered which were not seen before, he wished to ask Mr. Bowerbank to what extent these magnified images might be again magnified, and what advantages might be obtained by the process?

Mr Bowerbank said, no good was to be gained by magnifying any object beyond the point of obtaining a good definition. Referring to one of the specimens exhibited, he remarked that it was even too large to be of service for the purpose of physiological science; whereas, had it been taken by a low-power glass, with considerable penetration, instead of by a high-power glass with a large angle of aperture, he thought Mr. Kingsley would agree with him that it would have been better. With the greater number of microscopic objects, increase of size was not so much to be desired as extreme penetration. He was glad to see the progress which Mr. Kingsley and some other gentlemen were making in this department of the photographic art. In the last number of the *Microscopic Journal*, he understood there were one or two figures given, showing not only the possibility but the probability that periodicals would be illustrated in this manner, and thus much greater accuracy obtained than could be arrived at by means of the pencil. He hoped the time was coming, when photographic pictures in journals would be as common as those by the *camera lucida*.

Mr. Varley confirmed the observations of Mr. Bowerbank.

Mr. Samuel Highley, Jun., said that the value of the application of photography to the microscope could not as yet be sufficiently estimated; but undoubtedly it would perform a very important part in the advance of the science of microscopy, for not only were we enabled to multiply and distribute delineations of scarce objects, and thereby elicit the opinions of other observers, but in many instances where there was diversity of opinion and contradictory statements regarding minute structure, it would aid others in forming an opinion as to what had really been seen; as a faithful representation of what existed in the field of the microscope was insured to us, entirely free from the suspicion of having been delineated by a hand biassed by pre-conceived ideas. With the permission of the meeting, he would read a letter which he had that day received from Mr. Fox Talbot, as it conveyed information as to the first employment of sensitive media for securing delineations of magnified objects.

"Lacock Abbey, May 10, 1853.

"Dear Sir:—I have great pleasure in replying to your question. The first person who applied photography to the solar microscope was undoubtedly Mr. Wedgwood, as appears by his paper in the Journal of the Royal Institution for 1802; but none of his delineations have been preserved, and I believe that no particulars are known. Next in order of time to Mr. Wedgwood's, came my own experiments. Having published my first photographic process in January, 1839, I immediately applied it to the solar microscope, and in the course of that year made a great many microscopic photographs, which I gave away to Sir John Herschell, Sir Walter Calverley Trevelyan, and other friends. The size of these pictures was generally that of a half sheet of writing paper, or about eight inches square. The process employed was my original process, termed by me at first "Photogenic drawing," for the calotype process was not yet invented. I succeeded in my attempts, chiefly in consequence of a careful arrangement of the solar microscope, by which I was enabled to obtain a very luminous image, and to maintain it steadily on the paper during five or ten minutes, the time requisite. From the negative, positives were made freely, in the usual way. The magnifying power obtained was determined by direct measurement of the image and the object itself, which gave for result a magnifying power of seventeen times in linear dimensions, and consequently of 289 in surface. The definition of the image was good. After the invention of the calotype process, it became of course a comparatively easy matter to obtain these images; and I then ceased to occupy myself with this branch of photography, in order to direct my whole attention to the improvement of the views taken with the camera. I remain, &c.,

H. F. Talbot.

"Mr. Samuel Highley, Jr."

In a letter to the editor of the *Athenæum*, which appeared in that Journal last summer, Mr. Dallas again drew attention to the application of photography to the microscope, and stated that he had obtained very favorable results; but he did not give the details of the means employed. In the autumn of last year, whilst in Edinburgh, he (Mr. Highley) had an opportunity of seeing some of these views, but they were wanting in definition. In October, 1852, Mr. J. Delves introduced to the notice of the Microscopical Society, some very beautiful Collodion positive and negative pictures, in which the definition was

extremely sharp. This Mr. Delves attained by removing the eye-piece of the microscope, and inserting that end of the body into a dark chamber or camera, twenty-four inches in length; beyond this point the image was not sufficiently defined; the object was placed on the stage, the direct rays of the sun received on the mirror, and reflected in the direction of the axis of the microscope; the object was then focused on the ground glass of the camera, the sensitive collodionised plate replaced the focusing glass, and an image was obtained in from 10 to 60 seconds. As the chemical and visual foci did not coincide in microscopic object glasses, in consequence of their being *over-corrected*, allowance for this was necessary, and was effected by bringing the lens nearer to the plate by aid of the fine adjustment. The amount of correction varied with every object glass, and must be ascertained by direct experiments; but whilst the lower powers required a considerable amount of correction, the higher needed but a slight, if any alteration. Mr. Highley then introduced to the notice of the Society a microscopic camera, founded on the arrangement of Mr. Delves, but presenting the advantages of compactness, and being always arranged for immediate use; whilst to those photographers who were not already possessed of a microscope, it would be found an economical arrangement. It consisted of a tube which screwed into the flanch of a photographic lens, and carried the object-glasses. Over this fitted another tube, and by the sliding movement formed the coarse adjustment. This outer tube carried the stage and its fine adjustment on its upper side. To its under surface was attached a smaller tube, to which the mirror fitted, and which likewise carried the fittings for the polarizing prisms. Behind the object-glass was a fitting for the analyzer. Mr. Highley was of opinion that in many instances where the object was of a nature that depolarized light, advantage might be taken of this property to bring them up to *actinic* tints by the employment of polarized light and Darker's Selenite Stage; for whilst by this means the object would be of a color that would produce the greatest amount of chemical effect, the plates of selenite being *minus* the thickness and refracting power of the object, would produce a background several tints less intense in color and in actinic action. He referred to a diagram representing the various colors exhibited by a plate of selenite of varying thickness when viewed by polarized light, and likewise to the object itself in a polaroscope; also to another diagram representing crystals brought up to a deep blue by aid of selenite plates, the ground being of a greenish tint; and to the objects themselves arranged under polarizing microscopes. By such an application we should likewise probably be enabled to obtain representations of the internal structure and directions of tension in crystalline bodies. In reference to the asserted necessity for complete steadiness, Mr. Highley stated that Mr. Shadbolt had taken a great many views by the camphine light, in London, without any special arrangement for securing greater steadiness than was usually obtained in houses in London.

Mr. Kingsley [said that this was done with low powers; whereas the specimens which he had exhibited were taken with higher powers. He wished to show that the very highest powers of the microscope might be used, and that the light could be obtained for the highest magnifying powers they had. He had taken one as high as fifty thousand diameters; the time required being about ten minutes.

Mr. Bowerbank handed to the Chairman a photograph of a *Navicula angulata*, taken by Mr. Delves with a one-twelfth object-glass.

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## *On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain.* By MM. Ebelmen and Salvetat.*

(Continued from page 133.)

### 6. *Reds.*

It has already been stated, that the substance called *fan-hong*, contained both in the collection of the Musée Céramique and in that of the Ecole des Mines, although classed amongst the reds, was not a color, but only an oxide of iron serving as a base to several colors. The authors have found that four colors in M. Itier's collection contained this substance. Three of these were nothing but *fan-hong* mixed with a substance, the object of which is to fix and glaze the oxide of iron; to these M. Itier has

* From the London Chemical Gazette, No. 244.

given the names of *jaune orangé rouille*, *couleur de chair* and *couleur de rouille*. The fourth is a mixture of one of the preceding with the yellow *chang-hoang;* this is called *jaune sale* by M. Itier.

*Ta-hong, i. e.* strong red (ticketed *jaune orangé rouille*).—This is in elongated, amorphous, rounded, shining fragments, not friable, crushed with difficulty, and burning with a very distinct odor of glue. In the fire it loses 24·4 per cent. of its weight; with dilute nitric acid it gives a prolonged effervescence, and the fluid contains an abundance of lead. Boiling muriatic acid destroys its color completely. All these characters show that this color consists of a mixture of white lead (*yuen-feng*) with oxide of iron (*fan-hong*) and glue.

This color, laid upon porcelain, and exposed to a heat at which other colors become sufficiently glazed, became adherent only in the thin parts; the thicker portions remained pulverulent.

*Tse-hong*, or fine rose-red (ticketed *couleur de chair*).—This color is in bright red fragments, of a more rosy tint than those constituting the *ta-hong*. It is difficult to powder; and when calcined, exhales the characteristic odor of burnt glue. It effervesces with dilute nitric acid, which afterwards contains lead; its color is destroyed by boiling muriatic acid; it contains only a small per centage of silica. When applied to porcelain, it behaves exactly like the preceding red. The analysis of these two reds gives—

| | Ta-hong. | Tse-hong. |
|---|---|---|
| Loss by heat, | 24·40 | 23·40 |
| Silica, | 0·90 | 5·60 |
| Oxide of lead, | 59·00 | 62·52 |
| Oxide of copper, | trace | trace |
| Alumina and peroxide of iron, | 14·15 | 7·20 |
| Lime, | 1·00 | 1·00 |
| Magnesia, | trace | trace |
| Loss, | 0·55 | 0·28 |

Silica is wanting in both these colors, the small quantity found in the second arising probably from the addition of a little flux. This coloring oxide is not the only one which can be transformed into a porcelain color by the simple addition of oxide of lead, as we have seen in analyzing the Chinese porcelain-blacks. This mode of employment, from the want of siliceous flux, sufficiently explains why the colors only burn smooth in the thinner portions, remaining dull and powdery when laid on thicker.

These analyses confirm the statements of Father Ly with regard to *fan-hong*, in the descriptive catalogue of the collection of the Ecole des Mines: —"To every ounce 5 oz. of white lead are added, and the whole triturated together; the mixture thus formed is used as a color." In M. Itier's first red the oxides of lead and iron exist in the same proportions.

*P'ao-chi-hong, i. e.* precious stone-red (ticketed *couleur de rouille*). —This color differs completely from the preceding in the manner in which it behaves in the fire, glazing both in the thick and thin parts. It is with this color that the Chinese produce those shining red grounds, in the midst of which they frequently form, by scraping, white ornaments with the happiest effect.

It is a homogeneous red powder, emitting no odor of burnt glue when calcined. It effervesces only for a very short time with dilute nitric acid; the solution gives a black precipitate with sulphuretted hydrogen.

The color is destroyed by boiling muriatic acid. The solution behaves like a solution of iron in nitro-muriatic acid containing a little chloride of lead. Analysis:—

| | |
|---|---|
| Loss by heat, | 2·20 |
| Silica, | 36·10 |
| Oxide of lead, | 41·16 |
| Oxide of copper, | trace |
| Oxide of iron and alumina, | 17·00 |
| Magnesia, | trace |
| Lime, | 1·10 |
| Alkalies and loss, | 2·44 |

*Kou-tong*, *i. e.* old copper or old bronze (ticketed *jaune sale*).—This is a brick-red powder, which when burnt on porcelain gives only a dull yellow tint, without glazing; this is the behavior of a mixture of a yellow with an iron-red. The color therefore does not possess the tint which it exhibits after burning. Boiling muriatic acid destroys all its color; the resulting liquid contains antimony, lead and iron. Analysis:—

| | |
|---|---|
| Loss by heat, | 6·80 |
| Silica, | 22·00 |
| Oxide of lead, | 56·64 |
| Oxide of copper, | 0·20 |
| Oxide of iron, | 7·20 |
| Alumina, | 0·40 |
| Lime, | 1·40 |
| Magnesia, | trace |
| Antimonic acid, | 1·02 |
| Alkalies and loss, | 4·34 |

From this it appears that the Chinese understand the use of oxide of iron to produce both glazed and unglazed red colors, but it is remarkable that they should be ignorant of the different tints which may be obtained with this same substance, by exposing it during its preparation to a gradually elevated temperature.

Other Chinese reds, obtained by the authors from M. Itier's and Father Ly's collection, and from that of the Musée Céramique, are the following:—

*Seng-yen-tchy-hong*, or red of first quality, requiring no addition; for use it must be pounded (Ly).—This consists of brownish, lustrous fragments, externally vitrified, and presenting internally some pulverulent rose-colored portions. The external fragments give a rose-colored powder with a slight violet tint. This powder is the same as the

*Si-yen-tchy-hong*, or prepared red of first quality, used without addition of *yuen-fong* (Ly).—It contains some carbonate of lead. These two colors have the strongest affinity with the two following.

*Seng-ting-hong*, *i. e.* red of second quality, requiring no addition of *yuen-feng*; for use it must be pounded (Ly).

*Si-ting-hong*, prepared red of second quality, requiring no addition of *yuen-feng* (Ly).—These colors are attacked with difficulty by cold nitric-muriatic and nitro-muriatic acids. Hot concentrated nitric acid takes up a large quantity of oxide of lead and some silica, but part of this remains in a gelatinous state. The rose color is persistent, and seems to become concentrated in the residue insoluble in nitric acid. This residue is rapidly attacked by hot concentrated solutions of potash and soda, or their car-

bonates, leaving only a few blue flakes of finely-divided gold. Boiling nitro-muriatic acid destroys this color; there remains a deposite of silica and chloride of lead; the color disappears, and the liquid contains perchloride of gold. Boiling muriatic acid dissolves it with difficulty, and leaves an unattacked powder; the liquid does not contain any gold. The color contains neither tin nor boracic acid; its essential constituents are silica, oxide of lead, potash, soda and gold; its inessential constituents, alumina, copper, iron, lime and magnesia. The analysis of the two colors in both states gives the following results:—

| | Yen-tchy-hong. | | Ting-hong. | |
|---|---|---|---|---|
| | Seng. | Si. | Seng. | Si. |
| Loss by heat, | 1·21 | 3·60 | 1·19 | 3·20 |
| Silica, . . | 40·00 | 38·80 | 39·71 | 38·30 |
| Oxide of lead, | 48·55 | 47·37 | 48·70 | 48·00 |
| Alumina, . . | 0·20 | trace | 0·45 | 0·29 |
| Peroxide of iron, | 0·31 | 0·30 | 0·23 | 0·30 |
| Lime, . | trace | trace | 0·41 | 0·15 |
| Magnesia, | 0·05 | trace | trace | trace |
| Potash and soda, | 8·00 | 7·54 | 7·90 | 7·60 |
| Oxide of copper, | 0·40 | 0·40 | 0·30 | 0·44 |
| Metallic gold, . | 0·20 | 0·25 | 0·20 | 0·30 |
| Loss, . | 1·08 | 1·74 | 0·91 | 1·42 |

The quantity of gold was determined in the dry way by fusing 10 grms. of the color with 15 grms. of tartrate of soda, 10 of borax, and 10 of fused carbonate of soda; the mixture was allowed to cool in the crucible, which was then broken, and the gold obtained by cupellation from the button of lead formed; the gold weighed 0·025 grm., which agrees with the quantity ascertained by the humid way.

From these analyses it appears that these four colors are identical. They came from King-te-tching; a sample of the following color, obtained by M. Itier at Canton, having the same composition, we may regard it as the general constitution of gold colors in China.

*Hong-hoa*, *i. e.* safflower-red (ticketed *laque rose sale*).— It is a rose-colored powder, slightly purple, which behaves with acids like the preceding colors. It is, in fact, the same substance, as may be seen from the analysis:—

| | |
|---|---|
| Loss by heat, . . . | 1·40 |
| Silica, . . . . | 41·78 |
| Oxide of lead, . . . | 44·13 |
| Oxide of copper, . . | 0·26 |
| Alumina and oxide of iron, . . | 2·40 |
| Lime, . . . | 1·60 |
| Magnesia, . . . | 0·11 |
| Metallic gold, . . | 0·38 |
| Alkalies and loss, . . | 7·94 |

M. Itier's collection contains two more colors, consisting of mixtures of this red with other colors which have already been noticed.

*Tsing-lien*, *i. e.* nenuphar-blue (ticketed *amaranthe foncé*).—A light violet powder, which under water is seen to consist of three differently-colored substances,—one colorless, the second rose color, the third blue. The mixture effervesces very slightly with dilute nitric acid.

*Hong-fen*, or red powder, literally red meal (ticketed *rose couleur cobalt*). —A pale rose-colored powder, consisting of a mixture of white and red powders. The authors have not been able to find the least trace of oxide of cobalt. The analysis of these two colors gave—

| | Tsing-lien. | Hong-fen. |
|---|---|---|
| Loss by fire, | 2·00 | 1·40 |
| Silica and oxide of tin, | 41·80 | 39·30 |
| Oxide of lead, | 45·16 | 48·25 |
| Oxide of copper, | 0·50 | 0·20 |
| Alumina and oxide of iron, | 0·60 | 1·00 |
| Lime, | 1 20 | 2·02 |
| Magnesia, | trace | 0·05 |
| Metallic gold, | 0·20 | 0 35 |
| Oxide of cobalt, | 0·20 | 0·00 |
| Undetermined substances, | 8·34 | 7·43 |

Thus, whatever be the source of the Chinese porcelain colors, they all present a very striking general character,—a slightly varying glass, composed of silica, oxide of lead, soda and potash, containing as silicates a certain per-centage of coloring oxide. The only exceptions are the oxides of iron and manganese, employed as reds and blacks; and this is the case only because these oxides, if dissolved in silica, no longer furnish red and black colors. No color contains borax or boracic acid. This peculiarity in the composition of the Chinese colors naturally induces peculiarities in the decorations which they are employed to produce, and thus it is that the Chinese and Japenese porcelain paintings acquire their distinctive character.

The multiplicity of colors produced in Europe by mixture is unknown to the Chinese, and they are even quite ignorant of many of our materials. Their coloring matters are limited to oxide of copper, gold, antimony, arsenic, tin, impure oxide of cobalt, oxide of iron and oxide of manganese. In Europe when they make use of these various oxides, they derive great advantage from substances unknown to the Chinese. Thus the tint of pure oxide of cobalt is modified by the addition of oxide of zinc or alumina, or sometimes of alumina and oxide of chromium; pure oxide of iron furnishes about ten reds; by combining different proportions of oxide of iron, oxide of zinc, and oxide of cobalt or nickel, pale and dark ochres are obtained; browns are prepared by increasing the quantity of cobalt in the composition of the ochre, and blacks by the suppression of the oxide of zinc, in the same preparations. Yellows are rendered paler by the addition of oxide of zinc or tin, darker by oxide of iron. Oxide of chromium, either pure or combined with oxide of cobalt, or with the oxides of cobalt and zinc, gives a series of greens, varying from yellowish green almost to pure blue. Metallic gold furnishes the purple of Cassius, which may be transformed at will into violet, purple, or carmine. Oxide of uranium and the chromates of iron, cadmium and baryta, furnish useful colors; and lastly, we employ the metals which are inoxidable in the fire, and the preparation of which requires a degree of chemical knowledge which the Chinese are far from possessing.

All these oxides are simply mixed in the European colors, whilst in the Chinese they are dissolved. In fact, the following analyses of materials known in France as enamels exhibit exactly the same composition as the

Chinese porcelain colors. These are enamels used for articles of bijouterie in copper, gold, and silver:—

| | Blue for copper. | Gold for copper. | Green for silver. |
|---|---|---|---|
| Loss by heat, | 1·00 | 0·06 | 0·10 |
| Silica, | 51·00 | 47·70 | 53·68 |
| Oxide of lead, | 34·57 | 31·19 | 25·30 |
| Oxide of cobalt, | 1·00 | 0·10 | 0·00 |
| Oxide of iron, | trace | 0·40 | 0·46 |
| Oxide of manganese, | 0·00 | 1·20 | 0·20 |
| Alumina, | trace | 0·26 | 0·60 |
| Lime, | 2·00 | 1·80 | 1·26 |
| Magnesia, | trace | trace | trace |
| Oxide of copper, | trace | trace | 0·60 |
| Metallic gold, | — | 0·46 | 0·00 |
| Potash and soda, | 10·43 | 13·23 | 17·80 |
| Oxide of tin, | — | 3·60 | 0·00 |

The fluxes which are used in enamelling on gold, silver and copper, and that which is applied over the painting called *sous-fondant* in France, may also be compared with the colors used by Chinese in the decoration of their porcelains; it will be seen that these compounds are similar. The only difference is in the degree of fusibility, which is greater in the Chinese enamels:—

| | Flux for silver. | Flux for gold. | Flux for painting (*sous-fondant.*) |
|---|---|---|---|
| Loss by heat, | 0·30 | 0·10 | 0·10 |
| Silica, | 48·10 | 53·60 | 44·82 |
| Oxide of lead, | 38·25 | 31·19 | 41·59 |
| Oxide of copper, | 0·32 | trace | trace |
| Oxide of iron, | 0·25 | 0·40 | 0·31 |
| Oxide of manganese, | 0·00 | 0·60 | 0·15 |
| Alumina, | 0·24 | 0·54 | 0·46 |
| Lime, | 0·60 | 1·26 | 0·82 |
| Magnesia, | trace | trace | 0·05 |
| Alkalies, | 12·04 | 12·31 | 11·70 |

The similarity exhibited by comparison of the composition of these enamels with the Chinese porcelain colors, is also shown in the behavior of both in the fire on porcelain. It has long been known that enamels will not burn on European porcelains, from their scaling off. The Chinese colors sent by Father Ly and M. Itier, when tried upon European porcelain at Sèvres, acted in exactly the same manner, whilst when applied to Chinese porcelain they burnt well in. The authors consider that the cause of this lies in the difference between the glaze of the two porcelains. It is stated in the former part of this paper, that the Chinese porcelain mass, being more fusable than the European, must therefore be covered with a more fusible glaze; and it is the introduction of lime into the glaze, which, diminishing its infusibility and modifying perhaps its dilatability, approximates its physical properties to those of enamels.

If the aspect of the Chinese porcelains be different from that of the European, if the harmony of their decorations appears more varied, it is, according to the authors, the necessary result of their methods. All their colors contain but little coloring matter; they only possess strength of tone when laid on to a thickness which gives their paintings a relief which it

is imposible to obtain by other means; the harmony of their paintings is the consequence of the nature and composition of their enamels.

In addition to samples of the colors used in China, Father Ly has also sent specimens of the gold employed there in the decoration of porcelain, of the substance used as a diluent, and of the pencils employed in laying on the colors.

### *Metal.*

Gold is the only metal used by the Chinese. Father Ly has sent two specimens, the one green the other yellow gold.

*Khong-tchhy-king* is prepared gold color of the first quality.

*Koang-king*, prepared gold color of second quality.

The samples resemble that known in Europe as *honey-gold* or *shell-gold*. According to Father d'Entrecolles, the gold is powdered and laid on the wet surface of a porcelain vessel until a thin layer of gold is formed. It is then dried; for use, it is diffused in a sufficient quantity of gum-water, and 3 parts of white lead mixed with every 30 parts of gold. It is curious that the proportion of gold and flux employed is the same as at Sèvres; the flux employed at that place, instead of white lead, is the basic nitrate of bismuth.

### *Diluents.*

The Chinese use water to dilute these colors, instead of oil of turpentine, which is employed for this purpose in Europe. Only a few colors require the addition of a particular substance to render their employment easy. This substance is called *yeou-p'hy-kao*; it is a size made of bullock's skin. The colors to which it is added are, according to Father Ly, *fan-hong*, *feng-hong* and *ching-lan*; but the authors have also found it in the black called *si-feng-liao* by M. Itier. It is this substance which produces the odor of burnt glue evolved by these colors on calcination.

### *Pencils.*

M. Itier brought from Canton an assortment of the pencils with which the Chinese of that place applied their colors to porcelain. The collection of the Ecole des Mines contains an assortment sent from King-te-ching by Father Ly. All these pencils are of a similar structure; they consist of a long hollow stalk, like a reed, in the interior and at the extremity of which some very long hairs are firmly fixed. According to Father Ly, "there are common and fine brushes: some serve for laying on various colors, others for painting delicate flowers, some for painting with common red, others with fine red."

### *Summary.*

This examination of the materials employed by the Chinese in the decoration of porcelain leads to the following results:—

1. The *muffle colors*, that is to say, colors which bake at a very low temperature compared with that necessary for the baking of the porcelain, are far less numerous.

2. The palette is not composed of colors properly so called, but of

*enamels;* that is to say, of plumbo-alkaline glasses, variously colored by means of a small per-centage of *dissolved* coloring oxides.

3. The composition of the glass is in general but little varied, and the coloration always slight: it is this lightness of tone, together with the liveliness of the tint, which gives the Chinese porcelains their characteristic harmony and richness.

4. The enamels are colored by oxide of cobalt, oxide of copper, gold, antimony, tin, and arsenic.

5. The enamels are applied with water, sometimes with the addition of some size formed of bullock's skin.

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There are also certain hard coloring matters employed by the Chinese in various ways, of which the authors have said nothing in their present memoir; they propose to make them the subject of a third and last memoir on this subject.—*Ann. de Chim. et de Phys.*, July 1852, pp. 332-365.

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*On the best Mode of Focusing the Photographic Apparatus.* By A. Claudet.*

Sir,—Not having the honor to belong to the Photographic Society, I have only just heard that one of its members proposed at one of the meetings some time ago, a new mode of focusing the instrument in order to obtain a broader effect in portraiture, or when artists make use of Photography for sketches, and studies for compositions of figures, &c.

Upon inquiry, I have found that the mode consists in endeavoring to place the object a little out of focus, instead of endeavoring to focus as correctly as possible.

The author of this suggestion being one of our most eminent miniature painters, and at the same time an experienced amateur in photography, his opinion deserves to be examined, and his views perfectly understood. I must own, that as a photographer, I was not a little startled at the announcement of this idea; but coming from such an artist as Sir William Newton, I would not pass a judgment without mature reflection; and I now wish to discuss the question, in order to discover if the means recommended by Sir William will fulfil the object he is aiming at, and if there are not some better means to arrive at the same result.

About eight years ago, when I began to adopt the practice of taking non-inverted portraits, I observed that I always obtained a more artistic effect when the image had been reflected by a prism, before being refracted in the camera obscura, than when I operated without a prism, and produced inverted portraits. Comparing the two different results with Mr. Talbot, the gentleman observed, that the pictures taken with the addition of the prism were softer and more harmonious than those taken without the prism; and in trying to explain the cause of the effect, we came to the conclusion, that the slight imperfection inseparable from the use of the best glass prism of a considerable thickness, which did not refract the rays in a mathematical regularity, but with a certain degree of

* From the Journal of the Society of Arts, London, No. 20.

confusion, owing to the want of the matter in all the parts of the prism being perfectly homogeneous, and that the softness of the effect was produced by the rays slightly overlapping each other where they ought to be separated.

I was struck with this fact, and I began a series of experiments on the subject. I placed before the plate in the camera a very finely-ground glass, and I found that the sharp image of a well-focused, first-rate object glass, was by that means considerably softened, and the effect was artistic. Some time after, mentioning this experiment to Sir David Brewster that eminent philosopher told me that he himself had found a great advantage in the production of positive Talbotype pictures, by placing between the negative and the positive a very thin sheet of tissue-paper.

If I rightly understand the idea of Sir William Newton, these results are exactly those which he wishes to obtain in endeavoring to operate a little out of focus; and I can well understand why a real artist is desirous of avoiding that too minute correctness of details in photographic portrait,—a composition produced by a perfect lens at its exact focus. But there is a means to produce a better effect than by putting the image out of focus, namely, by the interposition of a slightly opaque medium; and the following are the reasons for the preference.

If it were possible to have all the various planes of the subject or composition at the exact focus, a small error in that focus would be the same for all the various planes of the picture, and that error obtained on purpose might soften the harshness of detail, and produce on the whole a more artistic effect. But it is not so; there is only one plane for which we can get an exact focus; all the others are out of focus, and the more so they are father before or behind that plane. So that if the eyes are in the exact focus, the ears and the nose are out of focus, but not in a very conspicuous degree. If the body is turned on one side, and the shoulder and arm which are nearer the apparatus are in the exact focus, the other shoulder and arm are devoid of the same sharpness of outline; and when the shoulder and arm, the more distant from the apparatus, are in good focus, the front part of the body is not so sharp. In fact, the rays converging on one point, by crossing each other, form two opposite angles, the apices of both being on the point of convergence, and from that point the rays converging more and more, the confusion increases the more the objects are put out of focus.

It is, therefore, very clear that if we focus on the most important part of the subject, such as the face, and then push the tube of the lens in or out in the slightest degree, we have the means of softening the harshness of details of a too well defined face; but if we push the tube out, the parts before the face will be more confused than they were before; and if, on the other hand, we push it in, the parts behind will be more confused than they were before. The difference will be incongruous in both cases either for the nearer or for the more distant parts. The confusion in these parts will be such that the drawing will be false, and the outline deficient.

Therefore, as it is not possible to put all the parts of the picture out of focus in the same degree, and as by the interposition of a slightly opaque medium we may have the same degree of softening effect upon the whole

picture, it is preferable, in order to produce the artistic result aimed at by Sir William Newton, to focus the apparatus as correctly as possible for the middle plane of the picture, and to operate through such a medium as I have mentioned.

This subject is as important as Sir William asserts, and if examined carefully, some good may result from the inquiries. The idea is quite rational in its object; but I think that in considering the defects of altering the focus, he will find that it is inconsistent with the scientific considerations of the laws of optics, and for that reason impracticable.

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### *On an Arrangement for taking Stereoscopic Pictures with a single Camera.* By Mr. Latimer Clark.*

In introducing this arrangement to the notice of the Society, I do not wish to represent it as calculated to supersede the ordinary method of taking stereoscopic pictures, viz: with two cameras, or even as being so good as that method; but it possesses a few important advantages; the pictures are produced on one plate and by one operation, with no more trouble than an ordinary portrait, and being both formed by the same lens and developed by the same solutions, they are almost sure to possess uniformity of size, tone, and intensity. Many amateurs, too, already possessing one good lens and camera, will be glad to obtain stereoscopic portraits without incurring the expense and encumbrance of two others; lastly, they require no after-adjustment of position for the stereoscope.

The camera exhibited is adapted only to produce pictures of the size of those ordinarily purchased in the shops; the arrangement consists of two parts, viz. the camera frame, which contains the collodion or daguerreotype plate on which the images are successively impressed, and the contrivance for rapidly moving the camera laterally through the requisite arc without deranging the position of the image upon the ground-glass, or iodized plate.

The camera frame or plate-holder contains a narrow dark chamber of the usual construction, capable of receiving a glass plate about $6\frac{3}{4}$ inches by $3\frac{1}{4}$; we will call this portion the *slide;* it slides to and fro freely within the frame through a space of $2\frac{1}{2}$ inches or $2\frac{5}{8}$, which is about the distance between the eyes; to admit of this the frame must necessarily be 10 or 11 inches long, and it therefore requires some simple adaptation to fit it to the end of an ordinary-sized camera. In the front of the frame is an aperture about $2\frac{1}{2}$ inches square, closed by a sliding door, and capable of being contracted by an oval or other shaped diaphragm, which determines the size and the form of the two pictures impressed on the plate, and which may be varied at pleasure. The distance between the two pictures is determined by the lateral motion of the slide, viz. $2\frac{5}{8}$ inches, as stated before. After one of the two images has been impressed, the slide has to be shifted laterally at the same instant, and in the same direction as the camera itself, by means which I will presentlydescribe. The second image is then taken, and the frame removed.

In the foregoing contrivance it is necessary to obtain the focus by a

*From the London Journal of the Photographic Society, No. 5.

separate glass; but in the daguerreotype arrangement the focusing-glass forms part of the apparatus; the slide is here in three pieces; the centre piece is the focusing-glass, which, being hinged at the bottom, does not slide, but falls back out of the way. The two side pieces (each of which is a perfect dark chamber containing a sensitive plate) are now in a position to be drawn successively into the field of view opposite the front aperture, and the images impressed. This makes a very compact arrangement, and requires no door in front of the frame, the plates being exposed to light only when brought opposite to the central opening.

We now come to the means employed to guide the camera in its lateral movement, the object being all the while retained in focus. A strongly framed camera-stand carries a flat table about 20 inches wide by 16, furnished with the usual adjustments.

Upon this are laid two flat bars of wood, in the direction of the object and parallel, and about the width of the camera asunder; they are 18 inches in length; their front ends carry stout pins, which descend into the table and form centres upon which they turn; their opposite ends also carry similar pins, but these are directed upwards, and fit into two corresponding holes in the tail-board of the camera. Now when the camera is placed upon these pins and moved to and fro laterally, the whole system exactly resembles the common parallel ruler; the two bars form the guides, and the camera, although capable of free lateral motion, always maintains a parallel position. In this condition of things it is only suited to take stereoscopic pictures of an object at an infinite distance; but to make it move in an arc, converging on an object at any nearer distance, it is only necessary to make the two guide-bars approximate at their nearer end so as to converge slightly towards the object, and by a few trials some degree of convergence will be readily found at which the image will remain as it were fixed on the focusing-glass, while the camera is moved to and fro; to admit of this adjustment, one of the pins descends through a slot in the table and carries a clamping-screw, by means of which it is readily fixed in any required position. In order, however, to render the motion of the camera smoother, it is advisable not to place it directly upon the two guides, but to interpose two thin strips of wood lying across them at right angles beneath the front and back of the camera respectively (and which may be fixed to the camera, if preferred), and to dust the surfaces with powdered soap-stone or French chalk.

Lastly, it is necessary that the slide should be shifted laterally at the same instant as the camera. The means used for this are simple, and consist only of a pulley fixed to the right-hand side of the camera, round which passes a string which is temporarily attached to the slide, the other end being fixed to the left-hand side of the table. When the camera is drawn to the left hand, this string is long enough to allow the slide to be drawn to the left hand also; but when the camera is moved to the right, the reaction of the string draws the slide also over in the same direction, the variations in adjustment being compensated by the intervention of an elastic band.

The operation of taking a portrait is therefore thus performed. The focus having been adjusted for both positions, and the camera and the slide both drawn to the left hand, the door is raised and the plate ex-

posed—say, for five seconds—by one motion of the hand; the camera is then shifted to the right hand, the slide moving at the same time spontaneously: this occupies less than a second of time; and the plate in its new position having been exposed five seconds longer, the door is closed, and the operation completed—the whole sitting having been supposed to occupy eleven seconds.

The portraits thus taken may be either viewed as positives upon the glass, in which manner they form very pleasing portraits, or they may be transferred to paper; or, lastly, they may be transferred to another collodion plate, by direct superposition and exposure to daylight or gaslight; by this means a positive picture is obtained, which may be either viewed as a transparency, or backed with *white* varnish. The effect of this is good, and deserves greater attention than it has hitherto received.

With regard to the distance between the two positions of the camera, I know of no good reason why the natural distance of the eyes, viz. $2\frac{1}{2}$ inches, should be much exceeded. By moving the camera about four or five inches, a little extra relief is obtained without visible distortion; but if this distance be greatly exceeded, especially for near objects, they become apparently diminished in size, and have the appearance of models and dolls rather than of natural objects. I am aware, however, that there exists much difference of opinion on this subject.

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*Note on a new Portable Reflecting Stereoscope.* By C. Wheatstone, Esq., F. R. S.*

The most perfect and generally useful form of the stereoscope is that with reflecting mirrors described in my earliest memoir "On Binocular Vision," published in the *Philosophical Transactions* for 1838. Pictures of any size may be placed in it, at the proper point of sight, with the proper convergence of the optic axes, and it admits of every requisite adjustment to make the pair of binocular pictures coincide correctly.

I have described in my second memoir a portable stereoscope which folds into a small compass, and which is well suited for pictures not exceeding six inches by four. I have since constructed an instrument, very convenient for carrying about, which is adapted to exhibit pictures of the largest dimensions usually taken, as well as smaller ones, and which may be made use of either for mounted or unmounted pictures. When closed it occupies a space of 9 inches in length, 5 in breadth, and $4\frac{1}{2}$ in height; when expanded the instrument is 2 feet in length, 1 foot in height, and 9 inches in depth. The base and sides consist of jointed bars on the principle of the lazy-tongs; the two mirrors fold together back to back, and, by means of a hinge on their support, fall into a groove on the base fitted to receive them. On the top of each of the expanding sides a clip 9 inches in length receives the picture (which there is no need to mount on card-board), and holds it by the pressure of a suitably disposed spring; and a similar but detached spring clip is applied to the lower end of the picture in order to keep it flat and in a vertical position.

* From the London Journal of the Photographic Society, No. 5.

The pictures being fixed in the clips, so that their reflected images shall appear single and coincide in all their parts, the accurate adjustment to the sight of different persons is effected by sliding to and fro the pillar which supports the mirrors; the optic axes being caused to converge more as the mirrors are moved towards the eyes, and *vice versa*. As the height of the sides is variable through every degree, the pictures are easily adjusted to the same level by pressing on the side which is highest. The length of the base being also variable, the pictures, if it be required, may be placed at different equal distances from the mirrors. If the pictures are not straight with respect to the sheets of paper on which they are placed, one end may be brought lower than the other merely by drawing down that end so that it shall not enter the clip so far as the other.

The instrument is furnished with a pair of ordinary spectacle lenses, No. 24. If the pictures were so placed that their reflected images coincided when the optic axes made an angle of 15°, corresponding to the distance of 12 inches, no lenses would be requisite, as the distance of the binocular image, the convergence of the optic axes, and the adaptation of the eyes to distinct vision would have their customary correspondence. But, for reasons I have elsewhere stated, a much better effect is produced, and the objects appear larger and more distant, when the pictures are so placed that, to cause their most distant corresponding points to concide, the optic axes are parallel, or nearly so; in this case, however, in order to see the objects distinctly, the rays proceeding from them must be rendered less convergent, and for this purpose lenses are necessary.

The lenses are movable in a vertical direction, in order that they may be fixed at the proper point of sight; the effect of a stereoscopic picture greatly depends on its being thus viewed, though it is a circumstance which is very generally disregarded.

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### *Experiments in Screw Propulsion.**

In continuation of our notes on this subject, we have to record the following experiments:

The *Cadiz*, a new iron steamer of 950 tons and 220 nominal horse power, built by Messrs. Tod and Macgregor, and belonging to the Peninsular and Oriental Company, was fitted with a Griffith's screw, and tried at the measured mile, at Stoke's Bay, on the 16th June. Of ten runs made with the screw at various pitches, the most successful showed a superiority of a quarter of a knot over the common screw, whilst the vibration was very much lessened.

What, however, has most elated the friends of screw propulsion has been the repeated success of the *Bengal*, whose first voyage, considered beyond praise, has been even outstripped by her second. It appears, indeed, as a correspondent of the *Times* remarks, that "the days of paddle-box steamers are numbered," and the most inveterate supporters of the paddle are beginning to change their minds. The Peninsular and Oriental Company are gradually adopting the screw in their large fleet,

* From the London Practical Mechanic's Journal, July, 1853.

to the entire exclusion of the paddle. This step was first contemplated when the *Bombay*, *Madras*, *Formosa*, and one or two others, proved successful. The *Bengal* was constructed as a final experiment, and we need not wonder that the triumph she has achieved has brought the company to a decision. What steamers they still have on the principle now beginning to be called "old-fashioned," are, for the most part, to be allowed to wear out; but even such of these as are of a suitable shape, and are worth altering and repairing, are to be changed into screw steamers. The *Haddington*, of 1600 tons, is, it is said, to be so metamorphosed, being in need of repairs. The *Himalaya*, of 3500 tons, lately launched, intended to be a paddle-boat when commenced, was subsequently altered to a screw. Amongst those in progress, all screws, are the *Simla*, of 2600 tons; the *Candia*, 2200 tons; the *Pera*, 2200 tons; the *Nubia*, 2200 tons; and the *Colombo*, 1900 tons.

A comparison of the cost and expenses of the *Bengal*, with those of paddle-steamers of similar class, will give reasons for preference of the former, much more appreciable by the commercial mind than mere scientific considerations. The *Bengal* is of the same size as the *Orinoco*, *Parana*, and *Magdalena*, 2250 tons, belonging to the Royal Mail Steam Packet Company, and carrying the West India mails. These vessels have engines of 750 horses power, whilst the *Bengal*, with 470, or about two-thirds of this, has reached a greater speed than any of them. The *Bengal* has a very great advantage with regard to fuel, requiring but 45 tons per day, whilst the three West India boats consume from 85 to 90 tons. A reduction in the amount of fuel, besides diminishing that item of cost, brings with it a gain in the freight; for the *Bengal* could carry 600 to 700 tons of cargo, instead of the mere 250 or 300 tons which the West India steamers are capable of taking, in addition to their 1200 tons of coals. The *Bengal* cost, it is said, about 70,000*l.*, whilst the *Orinoco* cost from 95,000*l.* to 100,000*l.*; and, in addition to all this, is to be considered the difference, in wear and tear, in favor of the screw vessel. With facts like these before them, we cannot be surprised that the attention of men of capital and enterprise is at the present moment so strongly attracted to the new system of propulsion.

On the 18th June, Sir Thomas Mitchell's Boomerang propeller was again tried in the *Conflict*. The instrument employed on a previous trial had been made too weak, and broke almost at starting. On the last occasion no such casualty happened, and a speed of $9\frac{1}{8}$ knots was the average result, of eight runs at the measured mile, in Stoke's Bay. The numbers of revolutions averaged $63\frac{3}{4}$. This speed is said to be somewhat above that obtained in the *Conflict* with a common screw. The diminution of the vibration of the vessel was remarkable. The experiment was, in fact, decided in favor of the new propeller. The trials in Commodore Martin's squadron show that the *Conflict* is far from being a fast vessel, either under steam or canvas; and it is considered that, with vessels of finer lines, proportionately better results will be obtained with the Boomerang. It has continued to be successful in the *Genova*, whose experimental trip we have already recorded; this vessel, on her voyage home from Quebec to Liverpool, having averaged a knot an hour more than she had ever previously done with a common screw.

The attention of the public has also lately been called to another and newer system of screw-propulsion, the invention of Mr. Burch, whose beautiful models have been much admired. The invention is an improvement on Griffith's arrangement. The centre of the propeller is occupied by a large drum. The lines of the ship are made to run into the periphery of this drum, and continue beyond it, finally merging into the stern-post, so that the ship is in the shape of a cone at that part. The blades, of course, project outside the drum, and the water is acted on in an unbroken state, as it flows in straight lines along the ship's side, without winding in under the run, or impinging upon a central globe, as in Griffith's plan. The arrangement is, in fact, the carrying out of a suggestion, in reference to Griffith's screw, made in our own columns a few months back. Mr. Burch has hit upon a very ingenious plan of reducing the friction between the surfaces of the central drum and the casing in which it works. A small pipe, communicating with the atmosphere at its upper end, opens, at its lower end, near the centre of the surfaces to be lubricated; and it is expected that the centrifugal action will draw down the air, so as to interpose a film between the surfaces. The quantity must, however, be so regulated, that none shall pass out into the water on which the blades are acting; otherwise, some of their effect will be lost. The size of the central drum allows of the introduction of mechanism for swivelling the blades, and even of drawing them entirely within the drum. The principle possesses several good points, but the proportion of the cones in the models appeared much exaggerated. We understand the models are on their way to the New York Exhibition.

Since these notes were written, a further set of experiments have been made with Griffith's screw. The object was to test the new screw under both steam and canvas, the wind on the previous occasion not having been sufficiently strong to use the sails. The first trial was made with the angle of the blades set at a coarse pitch, when the engines made 22½ revolutions with the fore and aft sails set. In this manner the *Cadiz* went from Southampton docks to Stoke's Bay, a distance of 14 miles, within the hour, and subsequently ran the measured mile, with a light breeze, as follows:

| | Revolutions. | Steam. | Vacuum. | Time. | Speed. |
|---|---|---|---|---|---|
| 1st Run, | 22½ | 10¾ lbs. | 26¼ | 4′ 54″ | 12·245 |
| 2d Run, | 22½ | 10 " | 26¼ | 5′ 30″ | 10·909 |

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### *The Application of Chromo-Lithography.**

The present work, Mr. Wyatt tells us in a "Postscript," is "the most important application of Chromo-Lithography to assist the connexion which should subsist between Art and Industry which has yet appeared;" and, further, "that it has been produced upon a scale of magnitude, and with a degree of rapidity, unexampled in this or any other country." The Messrs. Day, it appears, were desirous of demonstrating on a great scale the capabilities of color printing as an auxiliary to industrial education. No expense was spared. Mr. Wyatt was chosen director, twenty distinguished draftsmen were at once set to work, and the whole of the

* From the London Athenæum, June, 1853.

drawings were made without having recourse to the assistance of any foreign artist. Then came the transfer to the stone:—and here Mr. Wyatt shall tell his own story:

"For the purposes of Lithography the original drawing requires, in the first instance, to be carefully traced. It is then retraced, or transferred to the stone, by interposing between the surface of the latter and the drawing a thin sheet of paper, prepared on the side next the stone with red chalk. The lithographer then draws upon the stone with a greasy chalk or ink, as the case may be, the whole of the outline of the subject, and as much of the shading as he may think necessary. On the conclusion of this drawing in black and white, the stone is sent to the printer, who, after chemically preparing it for the operation, takes off carefully as many impressions as there are colors required to perfect polychromy of the original drawing. These impressions on thin paper are laid, whilst yet moist, upon a corresponding number of supplementary or color stones, and passed through the lithograph press. By this means the outline of the first or key-stone is printed off upon each of the remaining stones of the series, and the artist is provided with an outline upon the latter, identical with that which existed upon the key-stone. Carefully analyzing the amount of each color in the original drawing, and noting the points of its predominance, where, in some cases, it is allowed to appear pure, and in others to enter only into the composition of broken tints, the artist proceeds to indicate upon each stone, in black chalk or ink, the requisite amount for each separate color. Great care is required to bear in mind the succession of these tints, and to make due allowance for it, since it is obvious that the last printed, by its greater or less degree of opacity, may tend to kill all that has been done before. Great attention is likewise required in order that, when the various stones are worked together, the filling in of one color shall exactly meet the space occupied by another, without either overlapping and producing dark edges, or leaving white lines or gaps between each tint."

The stones employed in working these one hundred and sixty plates are one thousand and sixty-nine in number, weighing in all about twenty-five tons. These twenty-five tons are now sent to the printer.

"Supposing the artist's work to have been satisfactorily terminated, much now depends upon the printer. Considerable hazard is incurred in the chemical preparation of the stone, since, if washed with acid of too great a strength, all the delicate lines will disappear; or, if etched with too weak a solution, there will be a general tendency in the tints to clog up and become overcharged. Still greater difficulties present themselves in so attaching the paper upon which the impression is taken to each of the stones, as to cause the successive colors to fall into exactly their proper places, or, in technical language, to cause the stone to 'register' well. Considerable practice is necessary before the requisite amount of dexterity can be attained in this respect; and few but those who have stood beside the press, and watched its practical manipulation, would give the workman credit for the degree of skill which is essential to a successful carrying out of this part of the operation. Where great rapidity is indispensable, these difficulties are materially increased; because, if any color

be too heavily printed, it will take so long to dry that it will for some time be impossible to work off the remaining tints upon the same impression."

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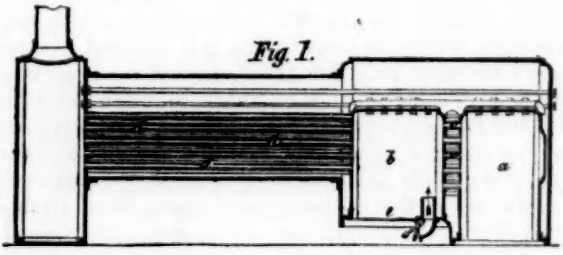
For the Journal of the Franklin Institute.

### *Milholland's Boiler.*

The April number of the *Journal* contains an account and engraving of Milholland's boiler for burning anthracite coal on the Reading Railroad. Is not this boiler identical with one patented in England, in 1845, by John Dewrance, published in Vol. xxix. of the London *Journal of Arts and Sciences*, the description of which reads as follows:

"The first part of this invention, viz: improvements in steam boilers, consists in the application to locomotive engine and other boilers of a box, chamber, or chambers, in addition to the ordinary fire box, whereby the combustible gaseous products of the furnace, in passing to the boiler flues, are caused to mix with atmospheric air, and become consumed.

*Fig. 1.*




*a*, is the fire box of a locomotive engine boiler; *b*, an air chamber, surrounded by the water in the boiler, in the same manner as it surrounds the fire box; *c*, *c*, *c*, are short flue tubes, connecting the fire box with the chamber *b*; or, in place of these tubes, the fire box and chamber may be connected by one or any number of flues. *d*, *d*, *d*, are the ordinary flue tubes; *e*, is the bottom plate of the air chamber *b*, fitting air-tight into its place; and *f* is a valve, by which atmospheric air is admitted, through a pipe or pipes, into the chamber *b*, for the purpose of mixing with the gases and smoke evolved from the combustion of the fuel in the furnace. These valves are to be regulated by the engineer, as occasion may require, so as to admit the quantity of air into the chamber which shall be found requisite for completing the combustion of the gaseous products of the fuel. The air being thus admitted into the chamber *b*, becomes mixed with the combustible gases arising from the fire in the furnace, and materially assists in their combustion. By this means a larger quantity of heat is evolved, and communicated to the boiler for the generating of steam, and thus an economy of fuel is effected.

"The patentee claims the use and application of an additional chamber or chambers, (such as the aforesaid chamber *b*,) in locomotive and other boilers, for the purpose of more perfectly consuming the combustible matters evolved from the furnace; but he does not confine himself to the

peculiar form of chamber shewn in the drawing, nor to the precise arrangement or form of the several parts which have been described; this part of the invention being the addition of an air chamber to locomotive and other boilers, for the purposes above described."

BRITANNICUS.

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*Observations, Economical and Sanitary, on the employment of Chemical Light for Artificial Illumination.* By Dr. E. FRANKLAND.*

Until the commencement of the present century, artificial light was derived almost exclusively from the animal kingdom; but the great economy attending its immediate production from our vast stores of vegetable fuel is becoming more and more apparent, and is in fact so generally admitted as to render more than a mere allusion to it and a glance at the following Table, unnecessary.—

Table, showing the comparative cost of light from various sources, each equal to 20 sperm candles burning 120 grains per hour each, for 10 hours.

| | *s.* | *d.* |
|---|---|---|
| Wax, | 7 | 2½ |
| Spermaceti, | 6 | 8 |
| Tallow, | 2 | 8 |
| Sperm Oil (Carcel's Lamp), | 1 | 10 |
| London Gases, B, C, D, E,† | 0 | 4¼ |
| Manchester Gas, | 0 | 3 |
| London Gas, E, | 0 | 2¼ |

Notwithstanding the great economy and convenience attending the use of gas, and in a sanitary point of view, the high position which, as an illuminating agent, coal gas of proper composition occupies, its use in dwelling houses is still extensively objected to. The objections are partly well founded and partly groundless. As is evident from the foregoing table, even the worst London gases produce, for a given amount of light, less carbonic acid and heat than either lamps or candles. But then, where gas is used, the consumer is never satisfied with a light equal in brilliancy only to that of lamps or candles, and consequently, when three or four times the amount of light is produced from a gas of bad composition, the heat and atmospheric deterioration greatly exceed the corresponding effects produced by the other means of illumination. By using a gas, however, of nearly the normal composition, such as the hydrocarbon gases above named, it is evident that three or four times the light may be employed, with the production of no greater heat or atmospheric deterioration than that caused by wax candles or the best constructed oil lamps. But there is nevertheless a real objection to the employment of gas-light in apartments, founded upon the production of sulphurous acid during its combustion: this sulphurous acid is derived from bisulphuret of carbon,

* From the London Athenæum, June, 1853.

†London Gases, A, B, C, D, E.—These are the gases furnished to consumers by five of the principal London Companies. For obvious reasons the names of the Companies are not mentioned.

and the organic sulphur compounds, which have already been referred to as incapable of removal from the gas by the present methods of purification. The formation of sulphurous acid can readily be proved, and even its amount estimated, by passing the products of combustion of a jet of gas through a small Liebig's condenser; the condensed product being heated to boiling with the addition of a few drops of nitric acid, and then treated with solution of chloride of barium, yields a white precipitate of sulphate of barytes, if any sulphur compound be present in the gas. These impurities, which are encountered in almost all coal gas now used, are the principal if not the only source of the unpleasant symptoms experienced by many sensitive persons in rooms lighted with gas. It is also owing to the sulphurous acid generated during the combustion of these impurities that the use of gas is found to injure the bindings of books, and impair or destroy the delicate colors of tapestry. Therefore the production of gas free from these noxious sulphur compounds is at the present moment a problem of the highest importance to the gas manufacturer, and one which demands his earnest attention. As it is nearly impossible for the consumer to procure gas free from these objectionable compounds, the only method of obviating their unpleasant and noxious effects is to remove entirely the products of combustion from the apartments in which the gas is consumed, and thus prevent them from mingling with the circumambient air. This suggestion was first made by Faraday, who, accomplishing this object, contrived the very beautiful and effective ventilating burner (in operation upon the lecture table). This apparatus, which is used at Buckingham Palace, Windsor Castle, the House of Peers, and in many public buildings, may be truly said to have brought gas illumination to perfection; for not only are all the products of combustion conveyed at once into the open air, but nearly the whole of the heat is in like manner prevented from communicating itself to the atmosphere of the room. The only obstacles to the universal adoption of this description of burner are, its expense, and the difficulty of conveying the ventilating tube safely into the nearest flue without injuring the architectural appearance of the room. The public at large will, therefore, await the removal of the objectionable compounds in question by the gas manufacturer, before they will universally adopt this otherwise delightful means of artificial illumination.—*Proc. Roy. Inst., May* 20, 1853.

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The allegation that the present method of gas purification will not remove all the sulphur, is certainly erroneous. We have seldom been able to find a trace of sulphur, either in the gas of our City, or in its products of combustion. The test alluded to, unless carried much farther, would not distinguish the sulphuric from carbonic acid. ED.

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### *A Suggestion in Gas Lighting.**

Every one who has had experience of rooms lighted with gas must be aware of the great heat produced by its combustion, and of the effect it has in diminishing the purity of the air, and therefore rendering it less

*From the London Builder, June, 1853.

fit for respiration. Now, I beg to propose, that in order to remedy these evils, each main gas pipe should be accompanied by another, conveying air from the external atmosphere, ramifying with all the pipes, and discharging its contents by openings alongside of all those from which the inflammable gas issues. The proportion of oxygen in atmospheric air, and the relative proportions of hydrogen and oxygen uniting in the combustion of these gases, require that the atmospheric air tubes and orifices should be as 5, and the coal gas tubes and orifices as 2. If gas pipes were fitted up in this manner, so that every burner should draw its supply of oxygen from the external air, and not from that of the room in which it is burned, the air of the latter would not be so much heated, nor so greatly diminished in purity. I offer these suggestions with great diffidence, and shall wait with anxiety for the opinions of architects on the subject.

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We recommend this simple suggestion to our builders and gas-fitters, as a simple, and probably very effective way of ventilating, and one which could be very easily made ornamental to the buildings in which it is introduced. *Ed.*

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## *On Oxygen.* By Prof. Faraday.*

The object of the speaker was to bring before the members, in the first place, M. Boussingault's endeavors to procure pure oxygen from the atmosphere in large quantities; so that being stored up in gasometers it might afterwards be applied to the many practical and useful purposes which suggest themselves at once, or which may be hereafter developed. The principle of the process is to heat baryta in close vessels and peroxidize it by the passage of a current of air; and afterwards by the application of the same heat, and a current of steam (with the same vessels), to evolve the extra portion of oxygen, and receive it in fitly adjusted gasometers; then the hydrated baryta so produced is dehydrated by a current of air passed over it at a somewhat higher temperature, and finally oxidized to excess by the continuance of the current and a lower temperature: and thus the process recurs again and again. The causes of failure in the progress of the investigation were described as detailed by M. Boussingault; the peculiar action of water illustrated; the reason why a mixture of baryta and lime, rather than pure baryta, should be used, was given; and the various other points in the *Mémoire* of M. Boussingault were noticed in turn. That philosopher now prepares the oxygen for his laboratory use by the baryta process. The next subject consisted of the recent researches of MM. Frémy and E. Becquerel "On the Influence of the Electric Spark in converting pure dry Oxygen into Ozone." The electric discharge from different sources produces this effect, but the high intensity spark of the electric machine is that best fitted for the purpose. When the spark contains the same electricity, its effect is proportionate to its length; for at two places of discharge in the same circuit, but with intervals of 1 and 2, the effect in producing ozone is as 1 and 2 also. A spark can act by *induction*; for, when it passes on the *outside* a glass tube

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containing within dry oxygen, and hermetically sealed, the oxygen is partly converted into ozone. Using tubes of oxygen which either stood over a solution of iodide of potassium, or, being hermetically sealed, contained the metal silver, the oxygen converted into ozone was absorbed; and the conversion of the *whole* of a given quantity of oxygen into ozone could be thus established. The effect for each spark is but small; 500,000 discharges were required to convert the oxygen in a tube about 7 inches long and 0·2 in diameter into ozone. For the details of this research, see the *Annales de Chimie*, 1852, xxxv. 62. Mr. Faraday then referred briefly to the recent views of Schönbein respecting the probable existence of part of the oxygen in oxy-compounds in the ozone state. Thus, of the peroxide of iron, the third oxygen is considered by him as existing in the state of ozone; and of the oxygen in pernitrous acid, half, or the two latter proportions added when the red gas if formed from oxygen and nitrous gas, are supposed to be in the same state. Hence the peculiar chemical action of these bodies; which seems not to be accounted for by the idea of a bare adhesion of the last oxygen, inasmuch as a red heat cannot separate the third oxygen from the peroxide of iron; and hence, also, according to M. Schönbein, certain effects of change of color by heat, and certain other actions connected with magnetism, &c.

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*Crayons for Writing on Glass.* By R. Brunnquell.*

The author prepares crayons for writing on glass, so as to enable the contents of glass vessels to be described immediately upon them in the following manner:—4 parts of spermaceti (or stearine), 3 parts of tallow, and 2 parts of wax are fused in a cup; 6 parts of minium and 1 part of potash are then stirred into it, the mass kept warm for half an hour, and then poured into glass tubes of the thickness of a lead pencil. After rapid cooling, the mass may be screwed up and down in the tube, and cut to the finest point with a knife. A crayon is thus obtained which will readily write upon clean dry glass.—*Dingler's Polytech. Journal*, vol. cxxvii. p. 236.

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## FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, August* 17, 1853.

George J. Ziegler, Esq., President, P. T., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A letter was read from C. F. Losing, Esq., New York.

Donations to the Library were received from The Austrian Engineers' Association, Vienna; The Institute of Actuaries, London; J. L. Losing, Boston, Mass., and from Messrs. C. H. Housekeeper, C. E. Smith, and Prof. J. F. Frazer, Philadelphia.

Donations to the Cabinets were received from Paul Moody, Esq., Camden, N. J., and Mr. John Creech, and Dr. M. B. Smith, Phila.

* From the London Chemical Gazette, No. 254.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement for July was read.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute (9) were proposed, and the candidates (5) proposed at the last meeting were duly elected.

Mr. G. W. Smith exhibited to the meeting, Polley's globular, elastic, adjustable, and expanding bucket for chain pumps, patented Dec. 14th, 1852, at Washington, and manufactured by H. Vivian & Co., East Kensington, Philadelphia. This bucket is a hollow sphere of caoutchouc, with thick walls; through the centre of the sphere passes a brass rod (with an eye on each projecting extremity), which is cut into a screw, on which traverses a nut and washer; the hollow sphere can, by turning the nut, be compressed so as to form an oblate spheroid of any desirable increased diameter, to fit the bore of the pump with the requisite precision.

G. W. Smith exhibited, at the request of the inventor, Mr. J. Z. A. Wagner, Philadelphia, a "Ship's Speed Indicator." Mr. S. briefly described the method of using the common log at sea, and its defects and advantages; he described, also, several kinds of apparatus which had been used for the purpose of determining the rate of speed of vessels at sea, such as Pitot's bent tubes, revolving vanes, screws, &c., and the various difficulties which have prevented their introduction hitherto. They all, in common with Mr. Wagner's, measure the velocity, or more directly, the pressure of the water at the depth where they are placed; as the velocity of the water near the surface of the ship, and at a little distance therefrom, is not equal, and moreover, varies in every vessel, according to its model, and the varying immersion of its cross section, it is evident that each indicator would require its index to be regulated in accordance with experiments tried with the particular vessel to which it is attached. No opinion was expressed by Mr. S., or by any of the members, respecting this indicator of Mr. Wagner. It consists of a vane attached to the side of the keel, by means of a rod, and folds up when not in use, after the manner of a door; when in use, it projects at right angles so as to receive the pressure of the water: from it rises a vertical stem, which ascends to the cabin or deck, passing, of course, through a stuffing box, the lower end of the rod terminating in a pivot resting in a step; at the upper end is a spring which is bent by the motion of the vane; there is also connected with it at this point, several wheels and pinions and rack, which transfer the movement to the dial or index.

The following remarks by Dr. Kennedy, were omitted in the proceedings of the meeting in July:

Dr. Alfred L. Kennedy invited the attention of the meeting to the many accidents constantly occurring from the insecurity of scaffolding erected around buildings. He regretted that more thought had not been bestowed upon the application of labor-saving machinery in the erection of buildings, and also in their repair. Steam hoisting machines for grain, and steam pile-driving machines had become quite common, but for